Professional MBA
Automotive Industry

Process Management and related quality aspects in the Automotive Industry

A Master's Thesis submitted for the degree of
"Master of Business Administration"

supervised by
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Baden/Austria Dec.2010

Affidavit

I, **ERNST WEIGL**, hereby declare

1. that I am the sole author of the present Master's Thesis, "PROCESS MANAGENT AND RELATED QUALITY ASPECTS IN THE AUTOMOTIVE INDUSTRY", 102 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and

2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 25.01.2011

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Signature

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LIST OF ABBREVIATIONS

Acronym	Definition
AIAG	Automotive Industry Action Group
ANFIA	Associazione Nazionale Filiera Industrie Automobilistiche (ANFIA/Italy)
APQC	American Productivity and Quality Centre
APQP	Advanced Product Quality Planning
BPM	Business Process Model
BSC	Balances Scorecard
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integrated
EFQM	European Foundation for Quality Management
EMAS	Eco Management and Audit Scheme
EOP	End of Production
FIEV	Federation des Industries des Equipements pour Vehicules
IATF	International Automotive Task Force
IDEF	Integrated DEFinition methods
IPC	Association Connecting Electronic Industries (originally Interconnecting and packing electronic circuits)
ISO	International Organization for Standardization
MDS	International Material data System (IMDS)
OEM	Original Equipment Manufacturing
PCF	Process Classification Framework
PDCA	Plan, Do , Check,Act
PMA	Process Maturity Assessment
PMI	Project Management Institute
PMM	Process Maturity Model
PPM	Parts per Million
QMS	Quality Management System
SCAMPI	Standard CMMI Appraisal Method for Process Improvement
SCC	Supply Cain Council
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference model
SEI	Software Engineering Institute
SMMT	Society of Motor Manufacturers and Traders (UK)
SOP	Start of Production
SPICE	Software Process Improvement and Capability Determination (Evaluation)
TC	Technical committee

TOC	Theory Of Constraints
TQM	Total Quality Management
TS	Technical Specification
VDA	Verband der Autohersteller

Table 1 List of Abbreviations

LIST OF DEFINITIONS

Term	Definition	Source
assessment	Assessment is an appraisal that an organization does to and for itself for the purposes of process improvement	http://www.sei.cmu.edu/library/abstracts/reports/06hb002.cfm
assessment instrument	a tool or set of tools that used throughout an assessment to assist the assessor in evaluating the performance or capability, in handling data and recording the assessment results	ISO 15504 3.6
capability dimension	the set of process attributes comprising the capability aspect of the reference model of processes and process capability	LOON van Han (PA & 15504)
customer	Organization or person who receives a product; Each of us is customer and supplier but not at the same time	ISO 9000:2005
evaluation	An evaluation is an appraisal in which an external group comes into an organization and examines its processes as input to a decision regarding future business or for monitoring current business	http://www.sei.cmu.edu/library/abstracts/reports/06hb002.cfm
Kaizen		
KPI	Criteria of success, remains stable while targets may change (increase or decrease)	lecture
method	a particular way of doing something	Cambridge Dictionary of American English
model		
process	set of interrelated or interacting activities which transforms input to outputs	ISO 15504
process	A process is a series of actions that you take in order to achieve a result	Cambridge Dictionary of American English

		LOON van Han (PA & 15504)
process attribute	a measurable characteristic of process capability applicable to any process	
process capability	the ability of a process to achieve a required goal	LOON van Han (PA & 15504)
process improvem ent	actions taken to change an organization's processes so that they more effectively and/or efficiently meet the organization's business goals	ISO 15504 3.40
process performan ce	the extent to which the execution of a process achieves its purpose	ISO 15504 3.45
process reference model	a model comprising definitions of process in life cycle described in terms of purpose and out comes, together with an architecture describing the relationships between processes	ISO 15504 3.48
product	Result of a process, may be a physical product or a service	ISO 9000:2005
supplier	Organization or person that provides a product (e.g producer, distributor, provider of a service)	ISO 9000:2005
TQM	Approach of company management focused on quality, which is based on the participation of all its members.	TQM John S. Oakland

Table 2 List of Definitions

ABSTRACT

Topic of the paper

By this master thesis the question on:

> Does the QMS/PMS[1] contribute and to which extent to
> satisfy customer requirements?
> Does the QMS/PMS structurally stimulate a continuous
> process improvement process?

should be answered.

The result of this Master Thesis should help an organization to
improve and develop their business processes, to increase
efficiency and customer satisfaction.

Subject matter and objectives

To develop an automotive business management model and an
automotive process improvement tool. To enable an organization
to improve and develop their business processes with the aim of
efficiency increase and sustainable customer satisfaction.

Hypothesis and methods used

Good People + Good Processes = Good Results

To collect the required information literature study, internet
research, norms and standards as well as customer requirement
specifications were studied prior to the development of the
model and tool.

Results

The result is an applicable tool to assess the maturity level of an
organization and to set up related improvement plans.

Conclusion/Future prospects

A quality driven organisation may use this tool to support their
continuous improvement process. The scope of the maturity
assessment tool is not completed within this master thesis. An
enterprise specific adaption based on their key business
processes is needed for completion of the tool.

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[1] QMS....Quality Management System; PMS....Process Management System

1 INTRODUCTION

1.1   Visualization of content structure
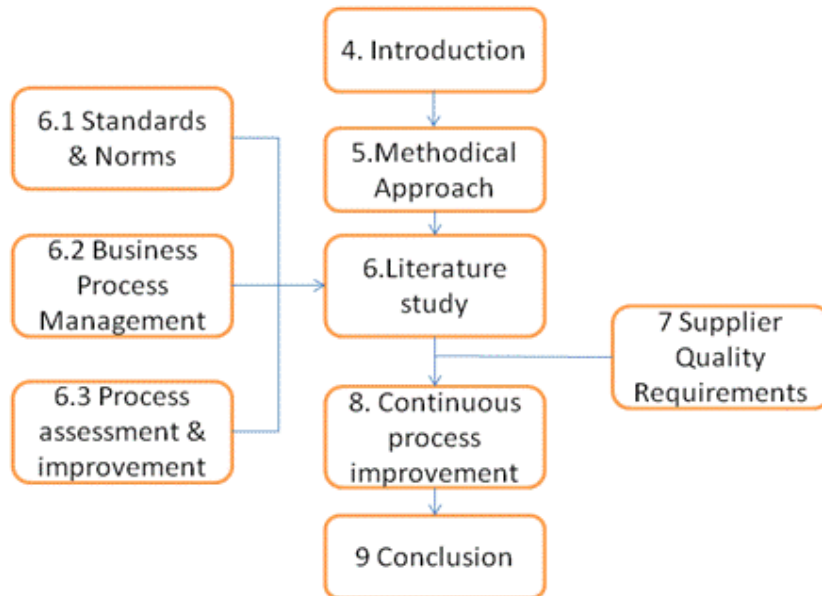
Figure 1, structural concept of the MT

1.2   Motivation

Within my long time working experience in the area of quality and process management I am frequently confronted with the contradiction of the bureaucratic approach of the norm requirements, the necessity for business flexibility due to customer and business requirements and the demand to continuously increase the organization efficiency. My motivation for this master thesis is to develop a practical tool, applicable for the automotive business processes with the pretension to resolve the mentioned contradiction.

1.3 Definition of the research problem

Customer requirements, acceleration of time to market, global acting companies and system requirements are some of the leading factors to implement a business process management system. The dominant motivation to improve mainly the financial results of a company concentrates the available resources and activities accordingly. Due to this the evaluation of the efficiency and effectively of the implemented process management system has not the priority it should have. Systematically continuous improvement of the process management system is executed on a low level of expertise and effort only or the potential improvement possibilities are ignored at all. Typically the used quality norm (e.g. ISO 9001, TS 16949) motivates an organization to reach and maintain a certain quality management system including process definition. However to strive for business excellence an additional push is required to move from a "certification reached mentality" to a company culture where self learning methodologies are an integrated asset of the enterprise and has the habit of never ending.

1.4 Outline of the main research question

Does the QMS/PMS[2] contribute and to which extent to satisfy customer requirements?
Does the QMS/PMS structurally stimulate a continuous process improvement process?

1.5 Hypothesis

> **Good People + Good Processes = Good Results*)**

*) the scope of this MT is limited to "good processes"

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[2] QMS....Quality Management System; PMS....Process Management System

2 METHODICAL APPROACH

2.1   Selection of background information

For the initial part -Standards, Norms - I used the most updated versions of the published norm documents. State of the art knowledge for the topic -Business Process Management -, as the essential input information for the part 3.2 of this Master Thesis, was found at the library of the TU Vienna. The summary of literature selection can be found at Table 8 Bibliography. Additional literature are from private sources and own books to feed this chapter on a broader scope. The customer requirements as used in the chapter Supplier Requirement Specification are documents public available on the Internet pages of the respective companies.

2.2   Literature study

Book reading, distillation of key messages and available research results to built on for the Master Thesis topic. Literature study is used to define state of the art knowhow for business process management. The evaluation of the customer requirements is based on current available documents issued by the respective customer.

2.3   Information retrieval

Library of the TU – Vienna; Internet research, Supplier sites on the Internet of Tier1and OEM customer; Continental Intranet for Norms, Standards and Process model; Discussion with experts working in the Quality and Sales department of Continental Austria;

2.4   Working methods

Development of the concept for the Master Thesis under consideration to find answers on the main research questions. Appropriate literature selection and realization of other valuable information sources. Capture of essential statements, models and theories supporting the answer on the research question and building the fundamentals for the master thesis research approach.

2.5 Research approach

The process requirements and definitions as mentioned in the norms are analyzed and described (see 3.1). In depth study of the literature for process management including process performance measurement are summarized at chapter 3.2.Chapter 0 deals with the available models for process assessment and improvement models.
Customer requirements are evaluated and communalities are documented in chapter 0 based on a selection of typical Tier1 customer, only John Deer is an OEM. In chapter 0 a methodical approach is worked out in order to find practical answers on the research questions outlined at 1.4

3 Literature study

3.1 Standards, Norms

In this chapter an insight in applicable standards and norms used as background for this master thesis is given.

3.1.1 Introduction to the ISO 9000 family

ISO/TC 176 is the "umbrella" committee under which the ISO 9000 series of quality management and quality assurance standards are being developed. There are three Subcommittees (SC), 1 Working Group and 3 Task Groups under ISO/TC 176 that are producing standards and guidance documents in the areas of:

SC1   Concepts and Terminology
SC2   Quality Systems
SC3   supporting Technologies
STTG   Spanish Translation Task Group
ATTG   Arabic Translation Task Group
CALG   Conformity Assessment Liaison Group

ISO/TC 176 has a Chair's Strategic Advisory Group (CSAG) to achieve a number of objectives associated with our Strategic Vision

The four standards are:

ISO 9000: Fundamentals and Vocabulary*:*
Describes the fundamentals of a Quality Management System (QMS) and specifies the terminology for a QMS.

ISO 9001: Quality management systems
Specifies requirements for a QMS where an organization needs to demonstrate its ability to provide products that meet customer requirements and applicable regulatory requirements and aims to enhance customer satisfaction.

ISO 9004: Guidelines for performance improvements*:*
Provide guidelines for both the effectiveness and efficiency of the QMS. The aim of this standard is the improvement of the performance of an organization and the satisfaction of customers and other interested parties.

ISO 19011: Guidelines for quality and/or environmental management systems auditing:
Provides guidance on auditing quality and environmental management systems

*Together the four standards (**ISO 9000, ISO 9001, ISO 9004**, and **ISO 19011**) form a coherent set of QMS standards*

facilitating mutual understanding in national and international trade.

<div align="right">(http://www.tc176.org/About176.asp; Oct. 2010)</div>

For a complete overview of standards issued by the ISO/TC 176 committee see Appendix 1, Documents issued by ISO/TC 176. The ISO 9000 (Fundamentals and vocabulary) and the ISO 19011 (Guidelines for quality and/or environmental system auditing) are not further considered by this Master Thesis.

The results of the literature study in the chapter 6.1.2 – 6.1.6 are documented in the following structure:

- Purpose and scope
- Condensed content
- Context to other norms/ QMS
- Short summary

3.1.2   ISO 9001:2008
Quality management systems – Requirements

Purpose and scope

ISO 9001:2008 is the standard that provides a set of standardized requirements for a quality management system, regardless of what the user organization does, its size, or whether it is in the private, or public sector.
It is the only standard in the family against which organizations can be certified – although certification is not a compulsory requirement of the standard.

Why an organization should implement ISO 9001:2008

Without satisfied customers, an organization is in peril! To keep customers satisfied, the organization needs to meet their requirements. The ISO 9001:2008 standard provides a tried and tested framework for taking a systematic approach to managing the organization's processes so that they consistently turn out product that satisfies customers' expectations.

How the ISO 9001:2008 model works

The requirements for a quality system have been standardized - but many organizations like to think of themselves as unique. So how does ISO 9001:2008 allow for the diversity of say, on the one hand, a "Mr. and Mrs." enterprise, and on the other, to a multinational

manufacturing company with service components, or a public utility, or a government administration?

The answer is that ISO 9001:2008 lays down what requirements your quality system must meet, but does not dictate how they should be met in any particular organization. This leaves great scope and flexibility for implementation in different business sectors and business cultures, as well as in different national cultures.

Checking that it works

The standard requires the organization itself to audit its ISO 9001:2008-based quality system to verify that it is managing its processes effectively - or, to put it another way, to check that it is fully in control of its activities.

In addition, the organization may invite its clients to audit the quality system in order to give them confidence that the organization is capable of delivering products or services that will meet their requirements.

Lastly, the organization may engage the services of an independent quality system certification body to obtain an ISO 9001:2008 certificate of conformity. This last option has proved extremely popular in the market-place because of the perceived credibility of an independent assessment.

(http://www.iso.org/iso/iso_catalogue/management_and_leadership_standards/
quality_management/iso_9000_essentials.htm; Oct. 2010)

In the ISO 9000:2005 the eight quality management principles are described.

Quality management principles

To lead and operate an organization successfully, it is necessary to direct and control it in a systematic and transparent manner. Success can result from implementing and maintaining a management system that is designed to continually improve performance while addressing the needs of all interested parties. Managing an organization encompasses quality management amongst other management disciplines.
Eight quality management principles have been identified that can be used by top management in order to lead the organization towards improved performance.

1. Customer focus
Organizations depend on their customer and therefore should understand current and future customer needs,

should meet customer requirements and strive to exceed customer expectation

2. Leadership
Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.

3. Involvement of people
People of all levels are the essence of an organization and there full involvement enables their abilities to be used for the organization's benefit.

4. Process approach
A desired result is achieved more efficiently when activities and related resources are managed as a process System approach to manage Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives

5. Continual improvement
Continual improvement of the organization's overall performance should be a permanent objective of the organization

6. Factual approach to decision making
Effective decisions are based on the analysis of data and information

7. Mutually beneficial supplier relationships
An organization and its suppliers are interdependent and mutually beneficial relationship enhances the ability of both to create value

(ISO 9000:2005, page v – vi)

This eight quality management principles forms the basis for the quality management system standards within the ISO 9000 family.

Condensed content of the ISO 9001:2008

The process orientation of the norm and the context to the Deming circle with the approach of continuous improvement can be seen in Figure 2, Model of a process-based quality management system.
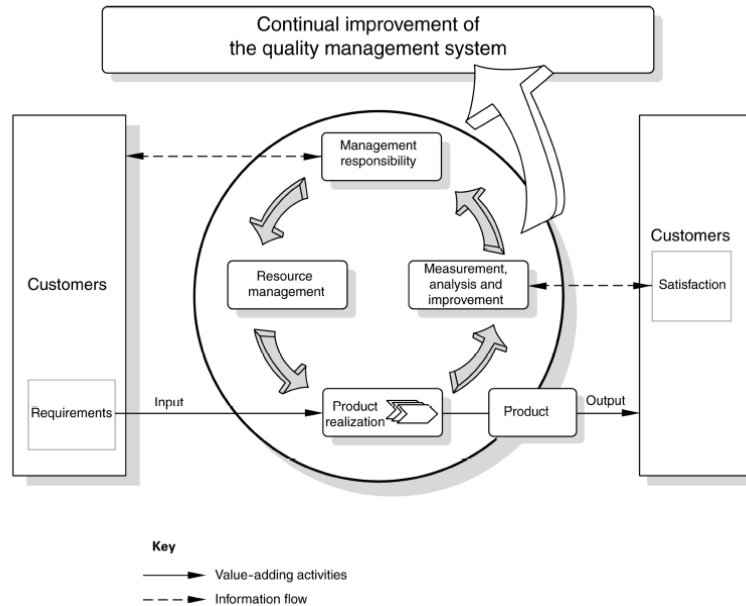
Figure 2, Model of a process-based quality management system

This model presents the input and output of a company represented by the customer requirements and the customer satisfaction while the business process of a company follows the Deming cycle of plan, do, check, act. The customer feedback is directly used to stimulate the improvement process.

The main chapters of the ISO 9001:2008 are

Quality management system
Management responsibility
Resource management
Product realization
Measurement, analysis and improvement

Context to other norms

The ISO 9001 norm forms the basis where other norms of the 9000 series as well as related norms built on. The ISO 9001 and ISO 9004 are quality management system standards which have been designed to complement each other, but can also be used independently. During the development of this international standard, due consideration was given to the provision of ISO 14001:2004 to enhance the compatibility of the two standards for the benefit of the user community.

The ISO/TS 16949 built on the basis of the ISO 9001. Major contents are use one to one by this norm. A more detailed consideration of this norm can be found at ISO/TS 16949. Short Summary:

The norm stimulates an organization to describe their organization and the way of working within the organization and with related stakeholders. The documentation has to be transparent and managed. The process definition and the interrelation between the processes is another cornerstone of this norm. Customer satisfaction, performance measurement and continues improvement demonstrates the dynamic requirements of the norm. A certificate of the compliance with the norm requirements can be obtained after successful assessment by an authorized certification body.

3.1.3 ISO 9004:2009
Managing for the sustained success of an organization – A quality management approach

Purpose and scope:

This international standard provides a wider focus on quality management than ISO 9001; it addresses the needs and expectation of all relevant interested parties and provides guidance for the systematic and continual improvement of the organization's performance.

This international standard promotes self assessments as an important tool for the review of the maturity level of the organization, covering its leadership, strategy, management system, resources and processes, to identify areas of strength and weakness and opportunities for either improvements, or innovations or both.

(ISO 9004:2009, p.6)

An extended model of a process based quality management system incorporating the elements of ISO 9001 and ISO 9004 is given in Figure 3.
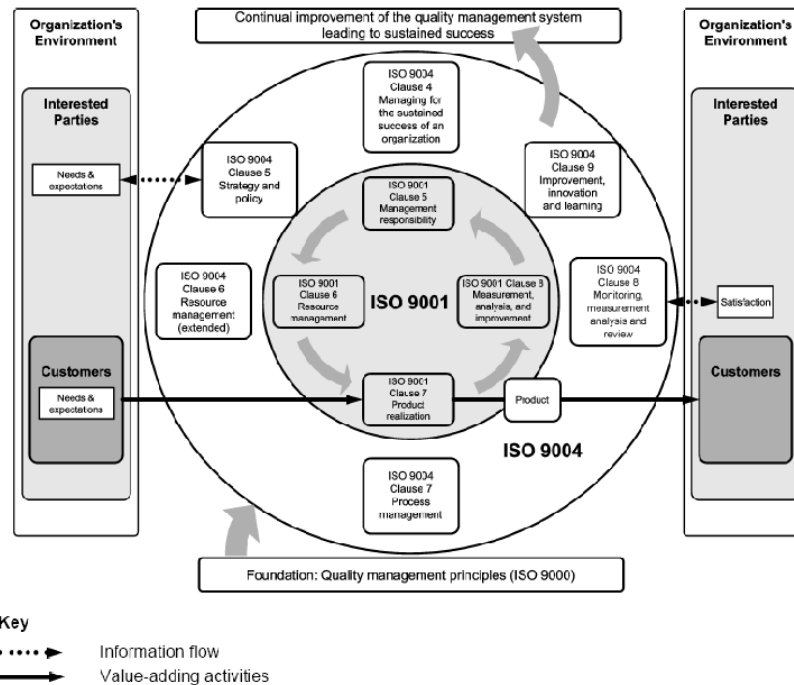
Figure 3; Extended model of process based management model

In comparison with the previous model (see Figure 2) the extended model includes the area of organizations environment including interested partners. In the outer cycle, additionally the clause 4-9 of the ISO 9004 are integrated in the model.

This international standard provides guidance to organizations to support the achievement of sustained success by quality management approach. It is applicable to any organization, regardless of size, type and activity. This international standard is not intended for certification, regulatory or contractual use.

(ISO 9004:2009, p11)

Condensed content of the ISO 9004:2009

The following chapters are outlined in detail:

4 Managing for the sustained success of an organization
5 Strategy and policy
6 Resource management
7 Process management
8 Monitoring, measurement, analyze and improvement
9 Improvement, innovation and learning

Context to other norms

As part of the ISO 9000 family the ISO 9004 fits perfectly in the framework and can be used in the context with system specific norms like the ISO 14001 or TS 16949

Short Summary

The aim of this norm is to secure a sustainable success of a company by continuous monitoring and improvement of the quality management system with the focus on processes and to consider all interested partners. Customer satisfaction as well as effectiveness and efficiency of the QMS are the driving force. A tool for self assessment is an essential part of this document. No certificate can be obtained.

3.1.4 ISO/TS 16949:2009

Quality management system – Particular requirements for the application of ISO 9001:2008 for automotive production and relevant service part organizations

Purpose and scope:

The ISO TS 16949 was prepared by the International Automotive Task Force (IATF), with support from ISO/TC 176 Technical Committee for Quality Management and Quality Assurance.

The TS 16949 is a quality management System specific for the automotive industry.

The norm title:

Particular requirements for the application of ISO 9001.2008 for the automotive production and relevant service part organizations.

Goal of this Technical Specification

> *The goal of this technical specification is the development of a quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain.*
> *This technical specification coupled with applicable customer specific requirements, defines the fundamental quality management system requirements for those subscribing to this technical specification.*
>
> *This technical specification is applicable to sites of the organization where customer specific parts, for production and/or services, are manufactured.*
> *Supporting functions whether on-site or remote (such as design centers, corporate headquarters and distributions centers) form part of the site audits as they support the site, but cannot obtain stand alone certification to this technical standard.*
>
> <div align="right">(ISO/TS 16949:2009, p.1)</div>

A more detailed definition of the scope can be found on the IATF (International Automobile Task Force) Webpage:

> *This Technical Specification, in conjunction with ISO 9001:2008, defines the quality management system requirements for the design and development, production*

and, when relevant, installation and service of automotive-related products. This Technical Specification is applicable to sites of the organization where production and/or service parts specified by the customer are manufactured.

"Automotive" shall be understood as including the following: - Cars, Trucks (Light, Medium and Heavy), Buses and Motorcycles

*"Automotive" shall be understood **to exclude** the following: - Industrial, Agricultural, Off-Highway (Mining, Forestry, Construction, etc.)*

"Site" - Location at which value added manufacturing processes occur.

"Manufacturing" - Process of making or fabricating:
- *Production materials*
- *Production or service parts*
- *Assemblies, or*
- *Heat treating, welding, painting, plating, or other finishing services*

(http://www.iatfglobaloversight.org/docs/FAQ%201%2009%20ISOTS16949%202020 09.pdf, Oct.2010)

IATF members include the following vehicle manufacturers: BMW Group, Chrysler Group LLC, Daimler AG, Fiat Group Automobiles, Ford Motor Company, General Motors Corporation (including Opel Vauxhall), PSA Peugeot-Citroen, Renault, Volkswagen AG and the vehicle manufacturer's respective trade associations - AIAG (U.S.), ANFIA (Italy), FIEV (France), SMMT (U.K.) and VDA (Germany).

For the explanation of the abbreviation of IATF, ANFIA, FIEV, SMMT, VDA, AIAG see Table 1 List of Abbreviations

Condensed content of the ISO/TS 16949:2009

In the table of contents of the TS 16949, ISO 9001:2008 headings are normal type face, IATF headings are in *italics*. In the remaining TS 16949 document the ISO 9001:2008 content is boxed.

The norm comprises of the following main chapters:

Scope
Normative References
Terms and Definitions
Quality Management System

Management Responsibility
Resource Management
Product Realization
Measurement, Analysis and Improvement

The subjects of the subdivision are only exemplarily with the focus on process management

The complete list of content can be seen in the norm

(ISO/TS 16949:2009, p.iii)

Context to other norms

In the introduction to this norm the context to the ISO 9000 family is mentioned, this includes in particular the ISO 9001 and 9004.
In chapter 0.4 compatibility with other technical specifications is stated, this norm has a high compatibility to the ISO 14001:2004 (Environmental Management System) as well as the

ability to incorporate specific standards of concerned organizations.

Short Summary

The ISO/TS 16949 is the most commonly used quality management standard in the automotive business. It represents the ISO 9001:2008 with specific requirements for the automotive application and is an almost mandatory prerequisite to sustain in the automotive supply business. The process focus is clearly mentioned in the conjunction with the ISO 9004. In chapter 8 the monitoring and improvement of processes is an explicit requirement. Certification based on this norm is common practice.

3.1.5 Verband der Automobilhersteller VDA
(Association of car manufacturers)

Purpose and scope:

The birthplace of the Association was in Eisenach. There, on 19 January 1901, the Verein Deutscher Motorfahrzeug-Industrieller (VDMI) - "Association of German Motor Vehicle Industrialists" - was founded by Gustav Vischer (manager of Daimler Motoren Cannstatt), Baron Eugène de Dietrich (Dietrich + Co. Niederbronn/Elsaß), Heinrich Kleyer (manager of Adler-Fahrradwerke Frankfurt/M.), Gustav Ehrhardt (manager of Fahrzeugfabrik Eisenach), Willy Tischbein (manager of Conti Gummi), Moritz Hille (Hille-Werke Dresden), Wilhelm Opel (Opel Rüsselsheim), Karl Fichtel (Fichtel + Sachs Schweinfurt), and Gustav Freund (manager of Automobiltechnische Gesellschaft, Automobilausstellung Berlin). The first president of the VDMI was Gustav Vischer, and his vice-president was Baron Eugène de Dietrich.

The tasks that the VDMI set itself included the promotion of road transport, defense against "burdensome measures by the authorities" (taxation, liability obligations), customs protection and the monitoring of motor shows. In 1923, the VDMI was renamed the Reichsverband der Automobilindustrie (RDA). The present name, Verband der Automobilindustrie (VDA) was given to this umbrella organization of the German automotive industry on 2 May 1946.

The VDA – The guarantor of future mobility

Sustainable and modern mobility are the main objectives of the VDA. The VDA nationally and internationally promotes the interests of the entire German automotive industry. It can bank on a strong power base of members consisting of automobile manufacturers, suppliers and manufacturers of trailers, special bodies and containers. Unlike in many other countries, they are organized under one association, resulting in decisive advantages for the German automotive industry through direct dialogue and rapid decision-making.

In the interest of all its members, the VDA is active in all areas of the motor traffic industry like economic and transport policy, technical legislation, quality assurance and taxation. In addition, the environment and climate protection are of particular importance. The VDA is also the organizer of international motor shows for passenger cars and commercial vehicles, which always draw the great interest of the experts and public alike

The German Association of the Automotive Industry (VDA) consists of about 600 member companies, who have come together to research and produce clean and safe auto-mobility for the future. In the country that is known for its successful invention of both automobiles and trucks, the VDA represents the automotive manufactures and supply companies to ensure the continued competitive utilization of their experience and skills. The cooperation between manufactures and suppliers in the VDA is unique in the world of motoring.

Since 1946, the VDA has lobbied nationally and internationally for the creation of the best possible auto-mobility. Our goals are safety, quality and sustainability at the highest technical level. As the representative of the key industry in the German economy, the VDA is responsible in the meantime for every seventh job in Germany and leads a lively dialogue with the industry, the public, politicians and customers, for example, as the organizer of the world's largest automobile exhibition, the International Motor Show (IAA).

(http://www.vda.de/en/verband/aufgabe.html, Oct.2010)

Currently the VDA has published 54 booklets in different languages; the majority of 36 are in German.

Below selected titles (not complete), titles written in German are available in this language only.

- Field failure analysis
- Maturity level assurance for new parts
- Standardized process for handling customers complaints
- Volume 2 Quality Assurance of Supplies
- Volume 3 Part 1 Ensuring reliability of car manufacturers- Reliability Management
- Volume 6 Quality Audit Fundamentals - Certification requirements for VDA 6.1, VDA 6.2, VDA 6.4 on the basis of ISO9001
- Volume 6 Part 1 QM - system audit
- Volume 6 Part 3 Process Audit
- Volume 6 Part 4 QM System Audit- Production Equipment
- Volume 6 Part 5 Product Audit
- Band 9 Qualitätssicherung Emissionen und Verbrauch
- Volume 14 Preventive Quality Management Methods in the Process Landscape
- Produktentstehung - Reifegradabsicherung für Neuteile
- Standardisierter Reklamationsprozess Sicherung der Qualität im Produktlebenszyklus

<div align="right">
(http://webshop.vda.de/QMC/index.php?
cPath=23_25&sort=1a&page=2, Oct.2010)
</div>

For this Master Thesis only the Volume 6.3 and Volume 14 are considered in more detail. These parts are dedicated to process and system audits as well as preventive measures.

QUALITY STANDARD OF THE GERMAN AUTOMOTIVE INDUSTRY (VDA 6)					
VDA 6	VDA 6 Part 1	QM-system audit Products	VDA 6 Part 2	QM-system audit Services	VDA 6 Part 4 QM-system audit Production equipment
Quality audit	VDA 6 Part 3	Process audit Serial production / Services			VDA 6 Part 7 Process audit Production equipment
Fundamentals	VDA 6 Part 5	Product audit (material and non-material)			

Figure 4, VDA 6, Quality Standard

<div align="right">
(VDA 6.3; 2nd Edition June 2010; p.3)
</div>

In this overview the context of the different parts of the VDA6 is shown. There is agreement between automotive manufacturers and suppliers to perform audits according these publications.

Condensed content of the VDA 6.3 and VDA 14

Volume 6 part 3; Process Audit for
- **product development process/serial production**
- **service development process/providing this service**

In this volume the audit process, the auditor qualification and the scoring methodology is explained. In the following picture the processes covered by the volume 6.3 are displayed.

P1: Potential analysis (new)
P2: Project management (new)
P3: Planning the product & process development
P4: Carrying out product & process development

P5: Supplier management
P6: Process analysis / production
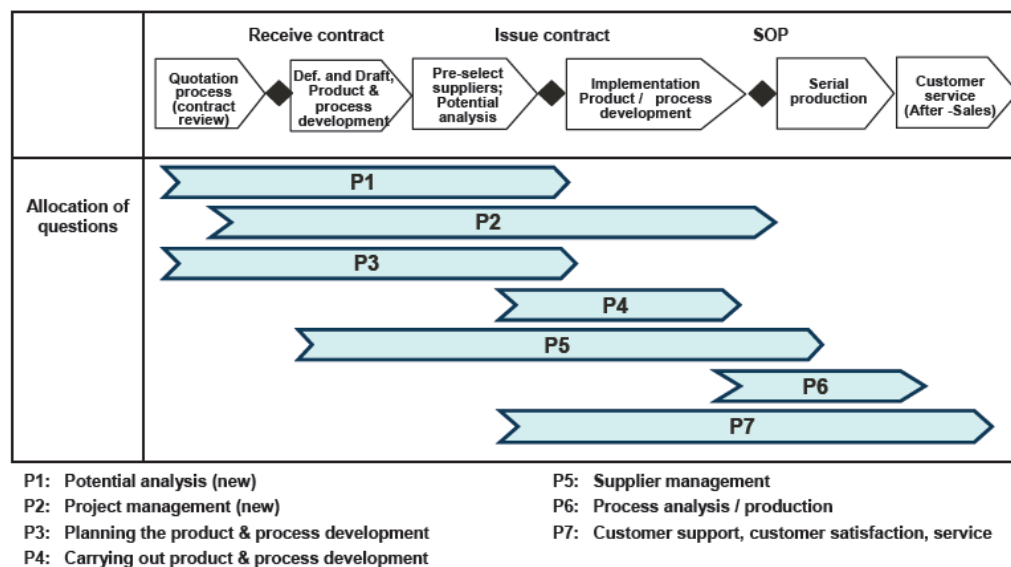P7: Customer support, customer satisfaction, service

Figure 5, VDA 6.3, process scope

(VDA 6.3; 2nd ed. June 2010; p.8)

The scoring for each element is according the table below

Points	Assessment of compliance with the requirements
10	Full compliance with requirements
8	Requirements mainly* satisfied; minor deviations
6	Requirements partially satisfied; significant deviations
4	Requirements inadequately satisfied; major deviations
0	Requirements not satisfied

Table 3, VDA Scoring systematic

(VDA 6.3; 2nd ed. June 2010; p.39)

Each question of a process element is evaluated following this scheme. The sum of all scores of this element divided by the sum of the maximum possible scores in percentage is the result of this particular process element. The result of a product group is the sum of related process elements with the same equation.

Classification	Overall level of achievement E$_G$ [%]	Description of the classification
A	E$_G$ ≥ 90	Quality-capable
B	80 ≤ E$_G$ < 90	Conditionally quality-capable
C	E$_G$ < 80	Not quality-capable

Table 4, VDA, overall achievement classification

(VDA 6.3; 2nd ed. June 2010; p.41)

The overall result of a process audit is according the mentioned schematic. Finally a supplier may be classified as an A, B or C class supplier.

Volume 14: Preventive Quality Management Methods in the Process Landscape

Preventive quality management methods (QM methods) are essential parts of the organization's respective quality management system. They contribute essentially to the successful corporate management in order to comply with customer requests, to implement robust processes and to launch reliable products onto the market.

In order to receive more reliability in the selection and use of the preventive quality management methods, extensive international studies were carried out. From the results of

these studies, a procedure was developed by the VDA working group of this volume that makes possible the selection of the most suited method for the use case and/or the problem solution as well as also the determination of the benefit.

(VDA 14; 1st ed. 2008; p.7)

The method is built on a 6 step model as shown in the Figure 6
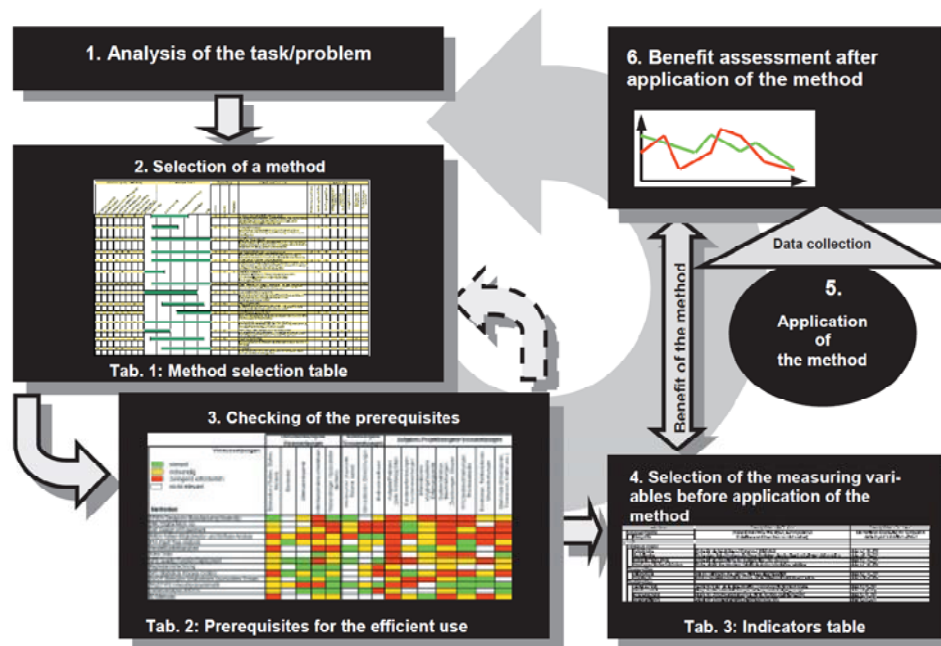
Figure 6, 6 Step model of the VDA 14

(VDA 14; 1st ed. 2008; p.18)

The steps are:

1) Analysis of the task/problem
2) Selection of a method
3) Testing of the prerequisites
4) Selection of the measuring variables before the use of the method
5) Application of the method
6) Assessment of the benefit after application of the method

The recommended methods, the timeframe of application in the project and the strategically objectives can be found in Appendix 4, Selection table for preventive measure.

The VDA 14 described in more detail all the quality preventive methods and the application of the 6 steps method.

The VDA 14 is not designated to be certified.

Short Summary

For the most important key process areas and customer requirements the VDA has a dedicated publication. The volume 6.5 product audit and the volume 6.3 process audit are the ones frequently used in the automotive supply business. The OEM's and Tiers make use of these guidelines either unchanged or modified according their requirements.
Both guidelines are not designated for certification while the VDA 6.1, 6.2 and 6.4 are certifiable quality standards.

3.1.6 ISO 15504:2004
Information Technology – Process Assessment
Purpose and scope

The ISO 15504:2004 was prepared by Joint Technical Committee ISO/IEC JTC 1, information technology, Subcommittee SC7, Software and system engineering.

The ISO 15504:2004 focus on how well a process is performed, managed, defined, measured and improved. The tool can be applied to any process under the condition of an existing reference model. In part 5 of the norm the ISO 12207 (System and software engineering – Software life cycle processes) is used as reference model. The ISO15504:2004 meets the requirements of the ISO 9001 for monitoring and measurement of processes.

Condensed content of the ISO 15504:2004

The norm consist of the following parts
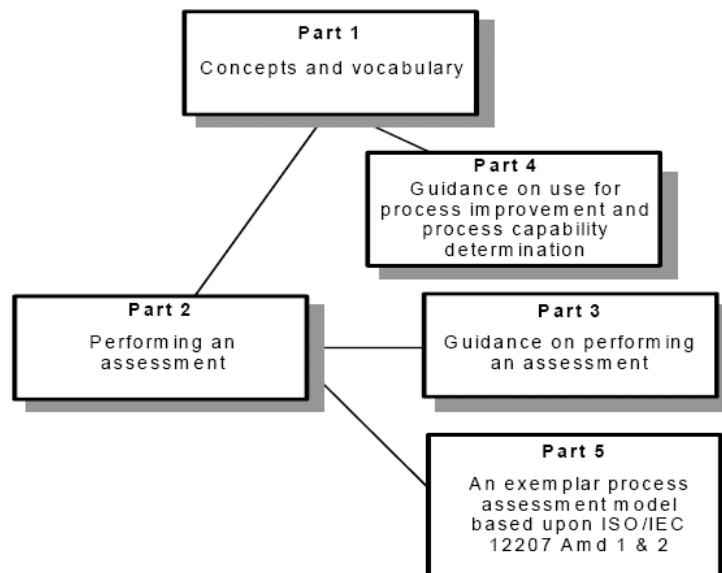
Figure 7, Components of the ISO/IEC 15504

The Figure 7 gives brief information of the content and the context of each part.
More detailed information of the content is mentioned in the next paragraph.

ISO/IEC 15504-1 provides a general introduction to the concept of process assessment and a glossary related terms

ISO/IEC 15504-2 sets out the minimum requirements for performing an assessment that ensures consistency and repeatability of the ratings. The requirements help to ensure that the assessment output is self- consistent and provides evidence to substantiate the ratings and verify compliance with the requirement.

ISO/IEC 15504-3 provides guidance for interpreting the requirements for performing an assessment.

ISO/IEC 15504-4 identifies process assessment as an activity that can be performed either as part of a process improvement initiative or as part of a capability determination approach. The purpose of process improvement is to continually improve organization's effectiveness and efficiency. The purpose of process capability determination is to identify the strengths, weaknesses and risks of selected processes with respect to a

particular specified requirement through the process used and their alignment with the business.

ISO/IEC 15504-5 contains an exemplar Process Assessment Model that is based upon the Process Reference Model defined in ISO/IEC 12207 Amd 1 Annex F and Amd2. An assessment is carried out utilizing conformant Process Assessment Model(s) related to one or more conformant or compliant Process Reference Models.

(ISO/IEC 15504:2004, p. V)

The basic model of the norm shows the main elements and its interrelation:
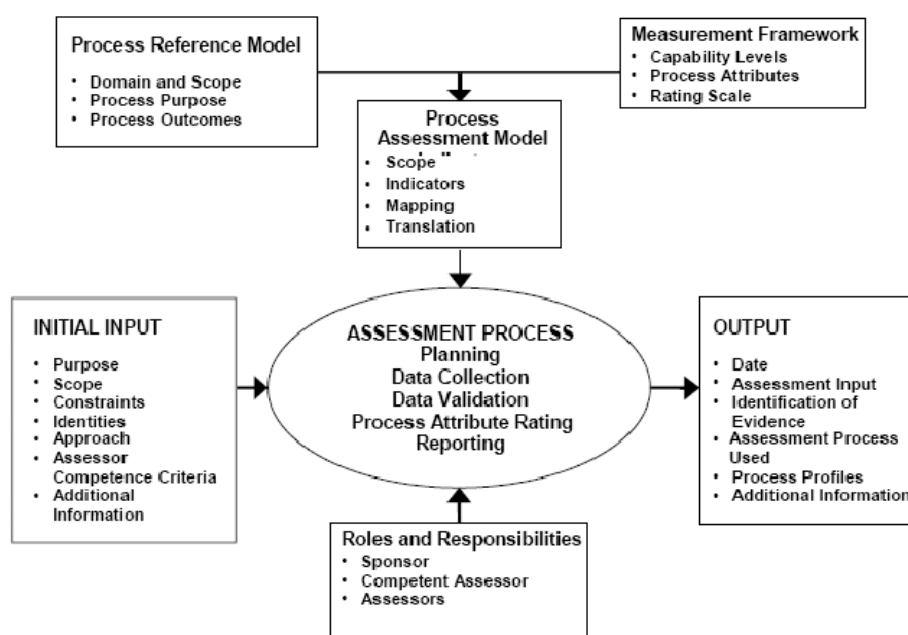
Figure 8, Major elements of the assessment process

The model in Figure 8 explains the structure of the norm. In the lower area of the figure the assessment process and the input information needed to perform an assessment are described. The assessment process as such and the roles needed to realize assessments are mentioned in this model. The expected output of the assessment process can be seen on the right side.
In the upper part of the figure the structure of a reference model needed for an assessment is shown. Important is the defined content of the reference model and the measurement criteria to realize an objective, repeatable and comparable assessment result.

The systematic of performance evaluation based on the ISO 15504:2004 is shown in the figure below:

Measurement
   Framework
- Capability Levels
- Process Attributes
- Rating Scale

mapping

Capability Scale

Process Assessment Model

1 2 3 .... n
Process entities

mapping

Process Reference Model
- Domain and Scope
- Processes with Purpose and Outcomes
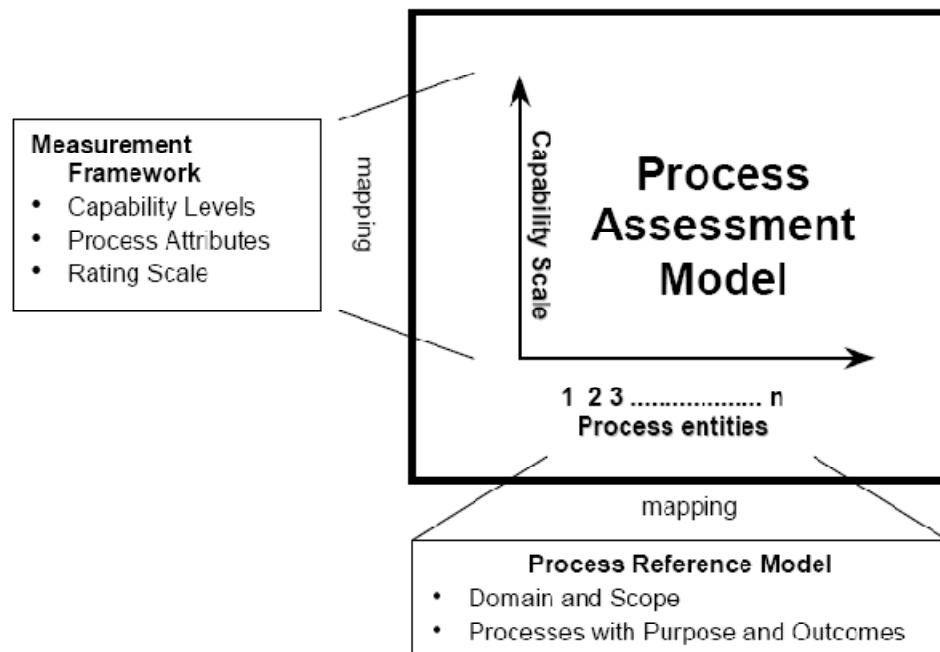
Figure 9 Process Assessment Model relationships

In Figure 9 the ISO/IEC 15504 shows the fundamental structure of the assessment model. On the horizontal axis the processes according the reference model are mapped while on the vertical axis the results of the current process capability level by rating the process attributes are noted. The diagram gives an overview of the process performance of the considered scope. Areas of improvement can easily be detected; areas of best practice can be used to be deployed in the entire organization.
The assessment has the goal to determine the capability level of a process.
The norm defines the requirements for a reference model and the assessment process and gives guidance to assess processes of an organization on how effective they are in achieving the goals related to process capability.

The model has defined 6 capability levels.
Level 0: Incomplete process
The process is not implemented or fails to achieve its process purpose
At this level there is little or no evidence af any systematic achievement of the process purpose
Level 1: Performed process
The implemented process achieves its process purpose

PA[3] 1.1 Process performance attribute
Level 2: Managed Process
The previous described – Performed Process – is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained.
PA 2.1 Performance management attribute
PA 2.2 Work product management attribute
Level 3: Established Process:
The previous described - Managed Process – is now implemented using a defined process that is capable of achieving its outcome.
PA 3.1 Process definition attribute
PA 3.2 Process deployment attribute
Level 4: Predictable Process:
The previous described- Established Process – now operates within defined limits to achieve its process outcomes.
PA 4.1 Process measurement attribute
PA 4.2 Process control attribute
Level 5: Optimizing Processes:
The previous described – Predictable process – is continuously improved to met relevant current and projected goals
PA 5.1 Process innovation attribute
PA 5.2 Process optimization attribute

(ISO/IEC 15504-2:2004, p.6-11)

To determine a capability level one or more process attributes has to be measured against the requirements. The judgment levels for the attributes are:

N – not achieved,	0 ……..	15 %
P – partially achieved,	>15 …….	50%
L – largely achieved	>50 ……	85%
F – fully achieved	>85 ……	100% achievement

(ISO/IEC 15504-2:2004, p.6-11)

At Capability level 1, the level of achievement is related to the performance of the process.
Capability level 2-5, the level of achievement is related to how well the process is managed, defined, quantitatively controlled and improved using a standard scale of good management practice.
The inherent continuous process improvement approach of the ISO/IEC 15504:2004 is demonstrated in the following figure:

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[3] PA…..Process Attribute
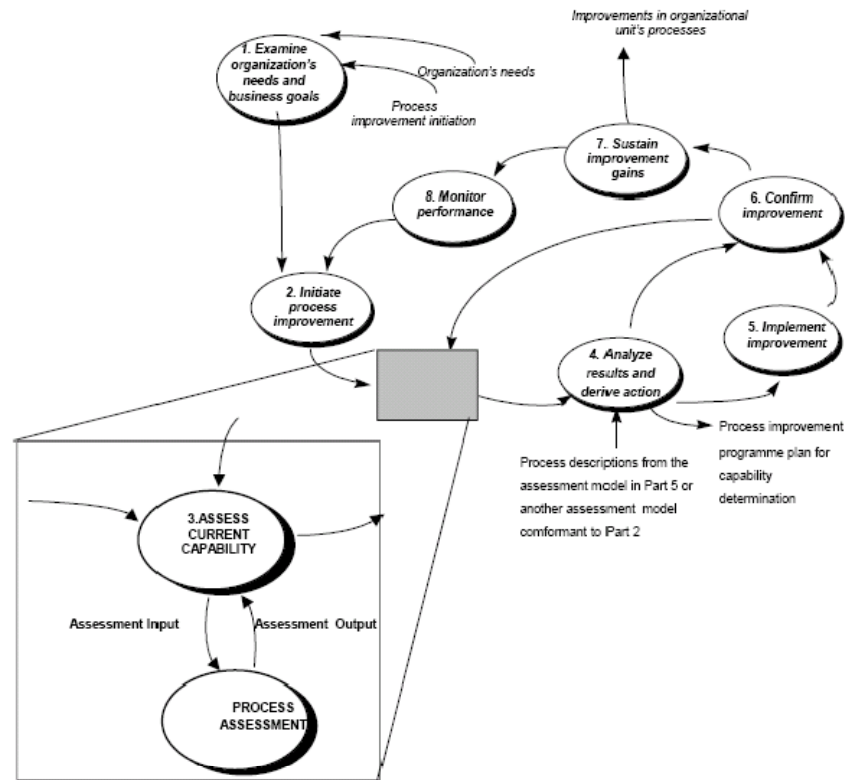
Figure 10, Process Improvement Model

(ISO/IEC 15504-1:2004, p.15)

This figure shows the implicit process improvement cycle of the norm model. Starting with the business ambitions ① the process improvement② is initiated. Process assessment ③is used to detect improvement areas. The analysis of the results ④leads to improvement measures ⑤followed by the determination of the effectiveness of the measures⑥. Continuous monitoring of the process performance ⑦and possible new input ①of business targets close the cycle.

Context to other norms/standards

Process measurement and continuous improvement is a requirement in almost all norms and Quality management systems. The ISO 15504:2004 is a practicable tool to perform process measurement. For SW process evaluation the ISO 12207 is used as reference model.

Business specific applications are mentioned below:

ITIL   IT services management processes
SPiCE   for SPACE,
OOSPICE   Object oriented technologies
ASPICE   for the automotive application

> *The leading automotive manufacturers in the German automotive industry through the Herstellerinitiative Software (HIS) investigated the various process assessment standards and chose to adopt ISO/IEC 15504. The group consists of Audi, BMW, Daimler, Porsche and VW group.*
>
> (Loon van Han, 2004b, p.155)
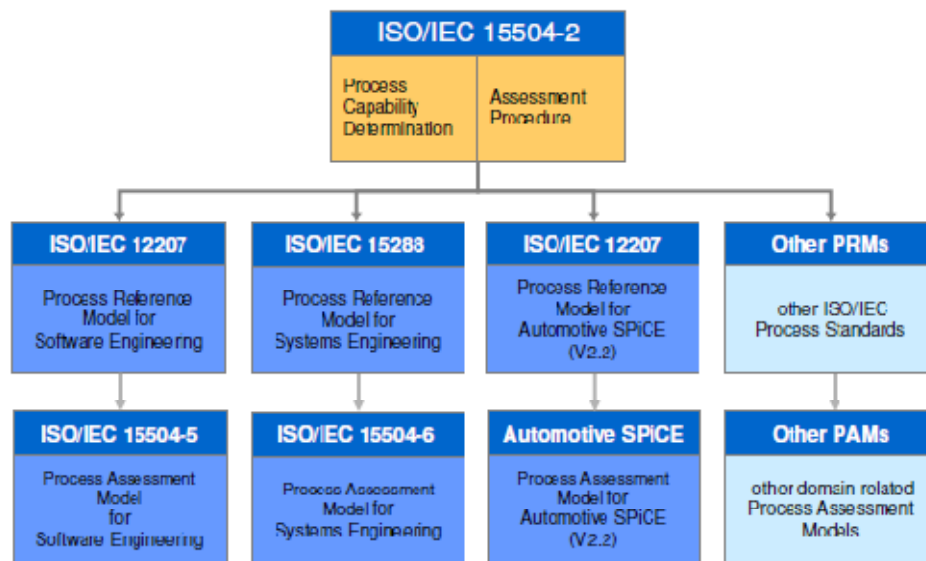
Figure 11, Existing reference models
(http://www.methodpark.de/ressourcen/download/praesentationen/category;Spice-news.pdf, 15.04.2008, Bernd.Hindel, accessed Nov. 2010)

Figure 11 show the existing reference models to the ISO 15504, Software engineering and Automotive spice are using the ISO 12207, system engineering the ISO 15288. Other process reference models will follow in the future.

Short Summary:

The ISO 15504:2004 is a model for an objective evaluation of processes capability to reach the targeted process output. The result of the evaluation tool is based on individual process or a set of processes. The norm model can be used for an individual

group of people like a project team and doesn't allow concluding the performance of a complete organization.

The result of an assessment reflects the current process capabilities in comparison with the organization needs and enables the organization to steer an improvement process initiative.

An assessment appraises the capability level of individual processes and not the level of the entire organization.

Based on the history of the norm, SW development process is the main area of application while at other areas like acquisition, hardware and mechanical development, production and SCM the application of this norm is limited.

3.2 Business Process Management

In this chapter these topics are explained:
Why business management; understanding the enterprise; business process architecture; process modelling and process performance measurement

3.2.1   Why Business Process management

Every organization wants to improve the way it does business, improve its ability to respond rapidly and dynamically to market forces and to competition, and to produce goods and services more efficiently, while increasing profits. Leading companies are increasingly using business process management techniques to define and align their processes, vertically and horizontally. At the same time they are implementing process governance and performance measurement systems to assure cost effective and consistent outcomes.

(Harmon P. 2007, front flap)

Have a computer program produces an incorrect result, we do not correct the result, rather we correct the program. Similarly, when a process produces an incorrect (product) result, we should not correct the product, but rather correct the process (the means) followed to produce it.

Organizations therefore define processes in order to minimize the negative aspect of variation in production of products and services. Furthermore to improve products, an organization can improve their people (through education) and/or improve the processes used. Improving the processes leads to more consistent, higher quality results.
(see 1.5 Hypothesis)

At the same time it is important that processes do not create restrictions or impose negative unproductive overheads in activities, especially in creative activities.
Bureaucratic aspects of processes or process rigidity can undo much of the benefit of processes. It is therefore important that processes are designed to suit the size of an organization, what product it produces and the people it employs. Processes need to be adaptable (tailorable) to suit the particular application within an organization.
(see 1.2 Motivation)

<div align="right">(Loon Han, van, 2004a, p6-7)</div>

3.2.2   Understanding the Enterprise

The first phase in the creation of a BPM is to understand the enterprise as a whole.
In this phase the executive committee and the senior executives of the company are involved. It is absolutely critical that everyone understand and agrees on the basic value chain processes (key business processes) the company supports and the strategic goals each value chain is responsible for achieving.

Of paramount importance is the answer to the core question each enterprise has to formulate for defining the mission: "Why do we exist?"
The mission statement set down in writing what basic principles are valid in the enterprise, the values and targets the managerial decisions should be based upon.
The lived mission statement creates a strong identity with the enterprise and results in advantages like:

> Unique character of the enterprise
> Common foundation of trust
> Valid for all employees
> Creates common understanding

<div align="right">(Wagner W.Karl, Patzak Gerold 2007, p.8, translated)</div>

In his 1980 book on Competitive Strategy, Porter described competition in most traditional industries as following one of three generic strategies:

> *Cost leadership*
> *Differentiation*
> *Niche specialization*

<div align="right">(Harmon P. 2007, p. 39)</div>

while Treacy and Wiersema, defined the three value propositions that companies must choose between are:

Product Leadership
Customer intimacy
Operational Excellence

<div align="right">(Harmon P. 2007, p.48)</div>

The achievement of the company or service vision and mission requires the development of businesses or service strategies, including strategic positioning in the market place. Plans can then be developed for implementing these strategies.

<div align="right">(Okland John S.2003, p.37)</div>

In the next phase the value chains of the organization has to be defined. The goal of each value chain and the relationship between core processes and managerial and support processes are also specified. Thus, specific business process architecture is developed for each individual value chain.

<div align="right">(Harmon P. 2007,p.61)</div>
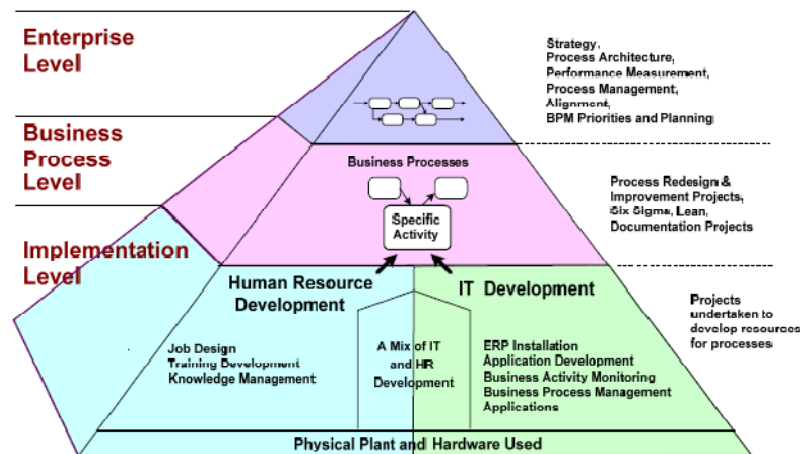
Figure 12, Business process pyramid [Harmon P. 2007. p.xxvii]

In this figure a basic structure of a business process model with focus on the process hierarchy is shown. On the Enterprise level Vision, Mission and Strategies are translated to a Business process management (corporate business process architecture). On Business Process level processes are more specific and on the implementation level process management support tools are implemented, trainings for new employees designed, job profiles created to realize the defined processes.
The figure should demonstrate the dependency of the different levels.

3.2.3   Business Process architecture

Systematic of business process definition:

Business processes consist of cross functional, value adding activities to realize customer requirements and have strategic importance to the enterprise. Business processes facilitate to overcome the fragmentation of the structural process chains within functional organizations and to concentrate the activities of a company to satisfy customer requirements. Alternative expression for business process could be key, core or corporate process.

The key steps involved in creating business process architecture are as follows:

> *Identify a specific value chain*
> *Determine the specific strategic goals the value chain is to achieve*
> *Determine how you will measure whether or not the value chain achieves its goal*
> *Subdivide the value chain into its major processes and sub processes*
> *Define who is responsible for the process, how to measure the performance and needed resources.*
>
> (Harmon P. 2007,p.82)

Example of a process landscape, presentation of the core processes:
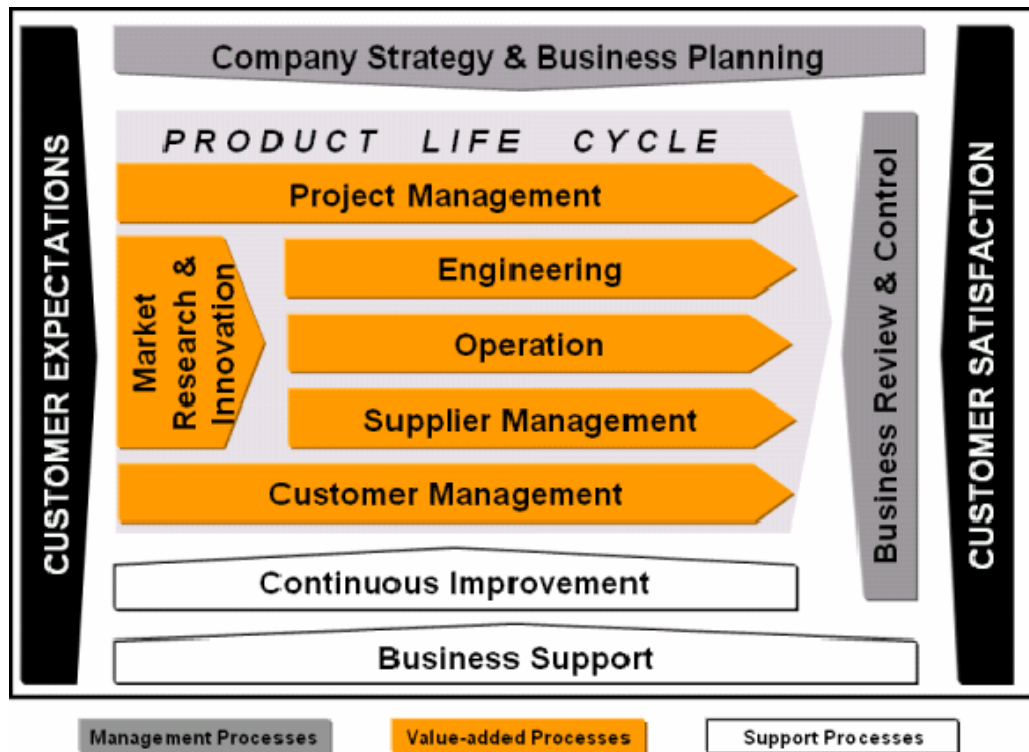
Figure 13, Example of a business process model

(Continental Automotive)

In this model the distinction of the processes in management, value added and support processes is clearly visible. The picture is an example of a high level overview on the core processes of an enterprise. The starting and ending point in the horizontal depiction is with the customer while the company strategy and support processes are shown in vertical direction. This model is very much linked to Figure 2, Model of a process-based quality management system mentioned in the ISO 9001.

Several IT tools exists to support the mapping and management of the processes, templates, job profiles like ARIS form IDS Scheer, Stages from Method Park Software AG, Corporate Modeler from Casewise, Websphere MQ workflow from IBM and Nautilus/Gedilan.

3.2.4   Process modelling

For the definition of "process" see Table 2 List of Definitions.

A business process consists of the following elements:

> Customer requirements
> Inputs
> Value creation
> Customer results
> Business process responsible
> Target and performance indicator to steer the business
> process
> > (Schmelzer J. Hermann, Sesseslmann Wolfgang 2002, p.35, translated)

For process modelling the "Integration Definition Function Modelling" (IDEF-0) can be used.
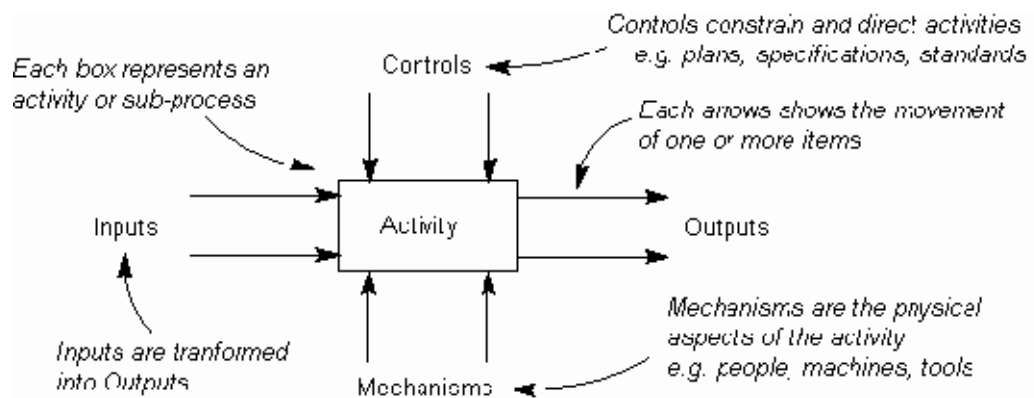
Figure 14, Key aspects of a process model
(http://www.syque.com/improvement/ICOM.htm, Nov. 2010)

> *The IDEF-0 model describes what a process does, what controls it, what things it works on, what means it uses to perform its functions, and what it produces. Meaning of arrows and boxes is standardized. Arrows on the left side of the box are inputs, which are transformed by the process to produce output arrows on the right side. Arrows entering the top of the box are controls which specify the conditions required for the process to generate the correct outputs. Arrows connected to the bottom from the box represent mechanism or resources.*
> > (Okland John S.2003, p.176)

More General

More Detailed

This box is the parent of
this diagram

NOTE: Node numbers shown
here indicate that the box has
been detailed. The C-number
or page number of the child
diagram could have been used
instead of the node number.
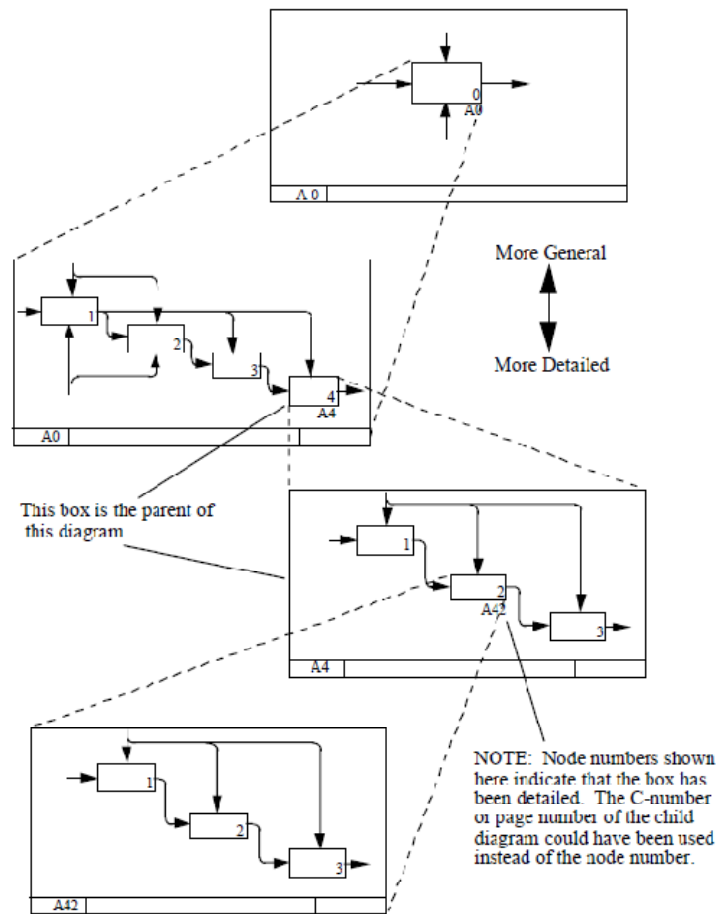
Figure 15, Process and sub process structure

(http://www.idef.com/pdf/idef0.pdf; page 16; Oct.2010)

The picture shows that process diagrams are broken down in more detailed diagrams, the top level diagram providing a description of the highest level process. This is followed by a series of child diagrams providing details of the sub processes.

The American Productivity and Quality Centre (APQC) have developed a Process Classification Framework (PCF) which can be used as a reference.
This framework supplies a generic view of business processes and can be tailored to a particular business.
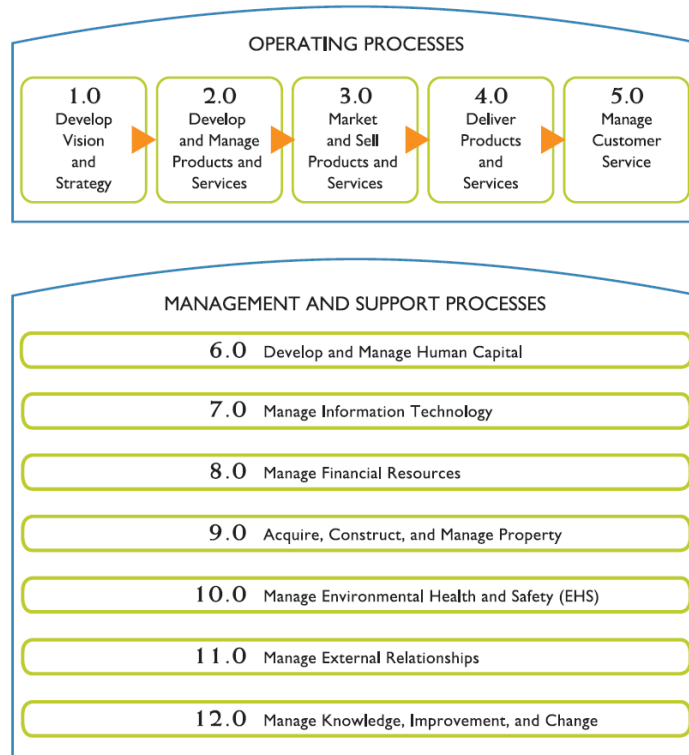
Figure 16, Process Classification Framework

The process classification framework overview (Figure 16) is shown in this picture. Each category (1-12) is divided in sub processes with the aim to offer a framework complete as possible and to deliver a harmonized vocabulary. Specific process classification framework (PCF) for the automotive business can be found at the APQC on http://www.apqc.org. To a certain extent the comparability of process performance from different companies by using the same framework, can be realized.

3.2.5   Process performance measurement

Several reasons exist to measure processes:

    To steer the process
Secure the reliability of processes respectively to detect deviations in the customer expectation in time
    Process evaluation

Continuously compare the process performance with the planned target

     Detect improvement potential
Process indicators are the starting point for analysis and deliver potential areas for improvement
     Effectiveness of changes
Performance measurement verifies the development of process performance comprehensive
     Positioning towards competitors
Quantification of process performance enables comparison with competitors
     Motivation effect
By performance indicators the success or bad success becomes appraisable and transparent
     Objective background for decisions
Measurement results contributes to the quality of decisions

(Jung Berndt, 2006, p 70-71, translated)

To ensure customer requirements have been met
To give indication of the cost of poor quality
To justify the use of resources

(Okland John S.2003, p.103)

Criteria for performance indicators:

     Must be important in respect to the business targets
     Must be easy understandable and explainable
     Must be sensitive to indicate deviations
     Data should be ease to retrieve
     Should support to steer the business
     Should have a logical interrelation

There are two ways of target setting:

The top down approach, targets are derived from the business strategy and the bottom up approach where the targets are driven by results of e.g. customer satisfaction measurement, analysis of problems, process benchmark and time comparison with previous results.
The condition for the top down approach is an updated business planning and is the preferred one.

The Balanced score card is a widely used tool to structure performance indicators in a defined context considering key process areas of an enterprise.

(Schmelzer J. Hermann, Sesseslmann Wolfgang 2002, p.176-177, translated)

The balanced score card
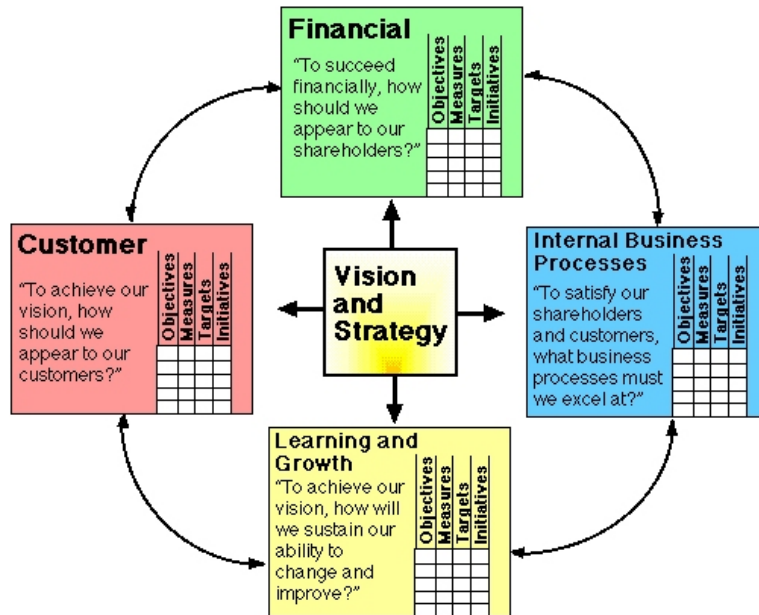
Figure 17, Balanced Sore Card
(http://www.balancedscorecard.org/BSCResources/AbouttheBalancedScore
card/tabid/55/Default.aspx,Nov.2010)

The principle structure of the BSC is the defined interrelation of the performance areas Learning and Growth, Internal Business Processes, Customer and Financials. Each performance area needs defined indicators with clear objectives, measures, targets and initiatives. All indicators are derived from and should support the vision and strategy of the enterprise.

In the next figure the linkage between the vision and the measures defined for the BSC is shown. The strategy is translated in critical success factors (CSF) and further on in concrete measures of the BSC.

Figure 18, Linking strategies to Balanced Scorecard Measures

(http://bptrends.com/deliver_file.cfm?fileType=publication&fileName=5%2D03%
20TB%20Evol%20of%20Balanced%20Scorecard%2Epdf;Harmon Paul page 2,
April 2003, accesed Nov.2010)

Summary

A business process management is the systematic to translate the object of an enterprise in a set of logical linked processes with the aim to establish the infrastructure the business targets are potentially to be achieved. A one-man business probably don't need a BPM however with increasing company size a process management system is indispensable to realize an effective way of working. An established process management system enables the organization to verify the process performance, to perform process reviews and subsequently process improvements. A BPM should help a new employee to learn effectively how the enterprise is functioning.

3.3   Assessments and improvement methods

The methods in chapter 6.3.1 - 6.3.5 are documented by the following structure:

    Method background, history
    Method description and structure
    Assessment guidelines
    Awarding principles
    Summary

3.3.1   Capability Maturity Model Integrated (CMMI)

Method background, history

Capability Maturity Model Integrated (CMMI)
is a process improvement approach that provides organizations with the essential elements of effective processes that ultimately improve their performance.
CMMI can be used to guide process improvement across a project, a division or an entire organization. It helps integrate traditionally separate organizational functions, set process improvement goals and priorities, provide guidance for quality processes, and provide a point of reference for appraising current processes.
(http://www.sei.cmu.edu/cmmi/index.cfm, Oct. 2010)

The CMM was originally developed to evaluate IT departments, the extended version, CMMI, is designed to help companies evaluate and improve any type of business process. You can either analyze the capabilities of a given department or group of practitioners or you can focus on the overall maturity of an organization. The first, which focus on capability levels, looks to see what skills are present and then focuses on teaching managers or process practitioners the skills that are missing. The second, which focuses on maturity level, assumes that organizations becomes more process savvy in a systematic, staged manner and focuses on identifying the stage the organization is at now and then providing the skills the organization needs to move to the next higher stage.
(Harmon P. 2007,p. 127_128)

Method description and structure

CMMI models are collections of best practices that you can compare to your organization's best practices and guide improvement to your processes. A formal comparison of a CMMI model to your processes is called an appraisal. The Standard CMMI Appraisal Method for Process Improvement (SCAMPI) incorporates the best ideas of several process improvement appraisal methods.

(http://www.sei.cmu.edu/cmmi/index.cfm, Oct. 2010)

Structures of the Continuous and Staged Representations

Level	Continuous Representation Capability Levels	Staged Representation Maturity Levels
Level 0	Incomplete	
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4		Quantitatively Managed
Level 5		Optimizing
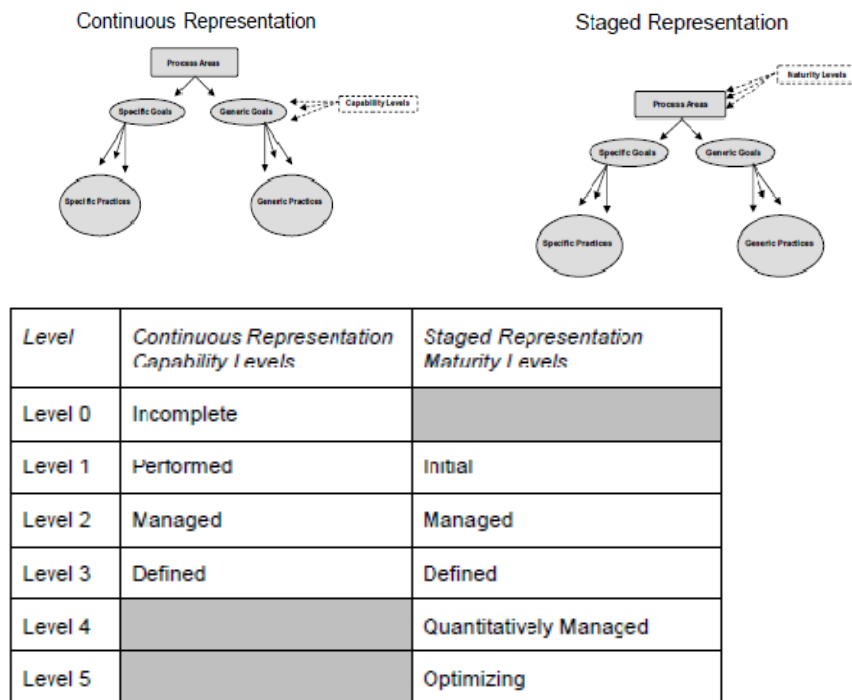
Figure 19, Comparison of capability and maturity level

(CMMI for Acquisition 2010, Version 1.3, p25)

Figure 19 illustrates the structures of the continuous and staged representations. The differences between the structures are subtle but significant. The staged representation uses maturity levels to characterize the overall state of the organization's processes relative to the model as a whole, whereas the continuous representation uses capability levels to characterize the state of the organization's processes relative to an individual process area. In the table the overlapping areas of the capability and maturity levels are shown.

Currently for three business areas a detailed assessment tool is available by the Software Engineering institute.

CMMI for Development Vers. 1.3
CMMI for Acquisition Vers. 1.3
CMMI for Services Vers. 1.3
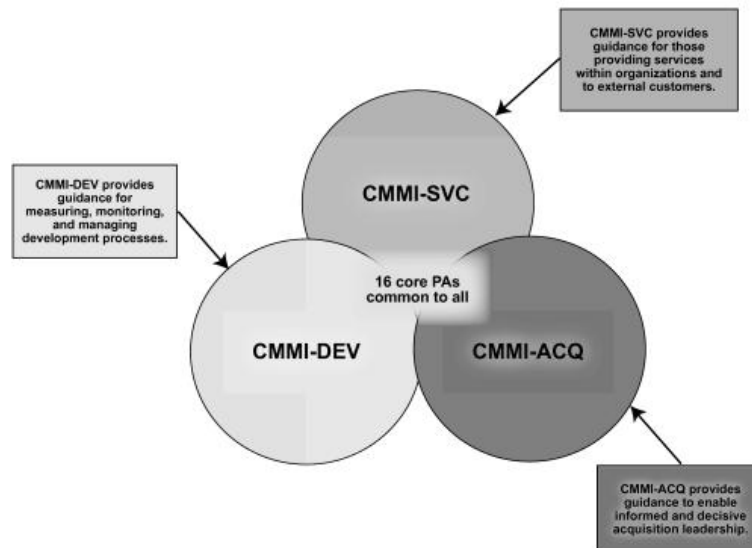
Figure 20, Relation of CMMI tools

Figure 20shows the interconnection of the three existing CMMI reference models. (CMMI for development, Services and Acquisition) .There are 16 Process Areas (PA) common for the three models, the remaining process areas are more specific to the assessment target of the dedicated model. Beside the common process areas the definitions, vocabulary and abbreviations are harmonized in the current version 1.3.

CMMI Framework

The CMMI Framework provides the structure needed to produce CMMI models, training, and appraisal components. To allow the use of multiple models within the CMMI Framework, model components are classified as either common to all CMMI models or applicable to a specific model. The common material is called the "CMMI Model Foundation" or "CMF."

The components of the CMF are part of every model generated from the CMMI Framework. Those components are combined with material applicable to an area of interest (e.g., acquisition, development, services) to produce a model.

<div align="right">(CMMI for Acquisition 2010, Version 1.3, p. 8)</div>

Assessment guidelines

The Standard CMMI Appraisal Method for Process Improvement (SCAMPI[4]) is designed to provide benchmark-quality ratings relative to Capability Maturity Model Integration (CMMI) models. It is applicable to a wide range of appraisal usage modes, including both internal process improvement and external capability determinations. SCAMPI A satisfies all of the Appraisal Requirements for CMMI (ARC) requirements for a Class A appraisal method. SCAMPI A enables a sponsor to

*   *gain insight into an organization's capability by identifying the strengths and weaknesses of its current processes*
*   *relate these strengths and weaknesses to the CMMI reference model(s)*
*   *prioritize improvement plans*
*   *focus on improvements (correct weaknesses that generate risks) that are most beneficial to the organization given its current level of organizational maturity or process capabilities*
*   *derive capability level ratings as well as a maturity level rating*
*   *identify development/acquisition risks relative to capability/maturity determinations*

As a Class A appraisal method, SCAMPI A is an appropriate tool for benchmarking. Sponsors who want to

---

[4] SCAMPI.....Standart CMMI Appraisal Method for Process Improvement

compare an organization's process improvement achievements with other organizations in the industry may have a maturity level determined as part of the appraisal process.

Decisions made on the basis of maturity level ratings are only valid if the ratings are based on known criteria. Consequently, contextual information—organizational scope, reference model scope, appraisal method type, the identity of the appraisal team leader and the team—are items for which criteria and guidance are provided within the method to ensure a consistent interpretation within the community. Benchmarking can only be valid when there is a consistent basis for establishing the benchmarks.

(Standard CMMI, Aug. 2006, page I-9)

Understanding Levels

Levels are used in CMMI to describe an evolutionary path recommended for an organization that wants to improve the processes it uses to capabilities, including products and services. Levels can also be the outcome of the rating activity in appraisals. Appraisals can apply to entire organizations or to smaller groups such as a group of projects or a division.
CMMI supports two improvement paths using levels. One path enables organizations to incrementally improve processes corresponding to an individual process area (or group of process areas) selected by the organization. The other path enables organizations to improve a set of related processes by incrementally addressing successive sets of process areas.
These two improvement paths are associated with the two types of levels: capability levels and maturity levels. These levels correspond to two approaches to process improvement called "representations." The two representations are called "continuous" and "staged." Using the continuous representation enables you to achieve "capability levels." Using the staged representation enables you to achieve "maturity levels."
To reach a particular level, an organization must satisfy all of the goals of the process area or set of process areas that are targeted for improvement, regardless of whether it is a capability or a maturity level.
Both representations provide ways to improve your processes to achieve business objectives, and both provide the same essential content and use the same model components.

(CMMI for Acquisition, 2010, Version 1.3, p.23 – 24)

Awarding principles and certificates

A formal CMMI certification of an organization's maturity level does not exist. When an assessor submits an assessment result to the CMMI steward, the steward only registers the assessment and does not clarify that the lead assessor has correctly assessed the maturity level of an organization.

Summary

The CMMI model is at typical maturity model evaluating the implemented process against a reference model. The reference is the collection of best practice for a particular area of concern. The concept is developed to assess a project, a division or an entire organization. The staged representation is used to assess the maturity level of an organization while the continuous model is used to assess the capability of a set of processes. For the appraisal the SCAMPI A methodology is used.

3.3.2   European Foundation for Quality Management

Method background, history

EFQM goes back more than 20 years, when 14 CEOs joined forces in 1988 to develop a Management tool that would increase the competitiveness of European organizations. Supported by the European Commission in the European Quality Promotion Policy, the founding members created the EFQM Excellence Model:

To stimulate and assist management teams in adopting and applying the principles of organization
To improve the competitiveness of European Industry
To close the gap of competitiveness between European and the USA and Japan

Today, we remain committed to the basis of our founding: to promote higher standards of management through shared learning among peers. This Mission now extends beyond the borders of Europe, to wherever organizations are willing to open their doors, understand and commit to instilling and adhering to the European Values on which on which the EFQM way to Excellence is founded.

The EFQM Founding Members are: AB Electrolux, British Telecommunications plc, Bull, Ciba-Geigy AG, C. Olivetti & C. SpA, Dassault Aviation, Fiat Auto SpA, KLM, Nestlé, Philips, Renault, Robert Bosch, Sulzer AG, Volkswagen.

(http://www.efqm.org/en/Home/aboutEFQM/Ourhistory/tabid/123/Default.aspx, Nov.2010)

Method description and structure

The EFQM model is a typical model to be used as self assessment tool. The model is a comprehensive tool to evaluate the performance of an entire organization. In comparison to other assessment tools the EFQM model assesses the organization's performance of almost all business areas as well as the impact to and from the stakeholder. The evaluation scope of the model has incorporated a track record of key performance indicators over a certain time period, hence an onetime high level of key performance has to be considered with the right achievement level in the score card.
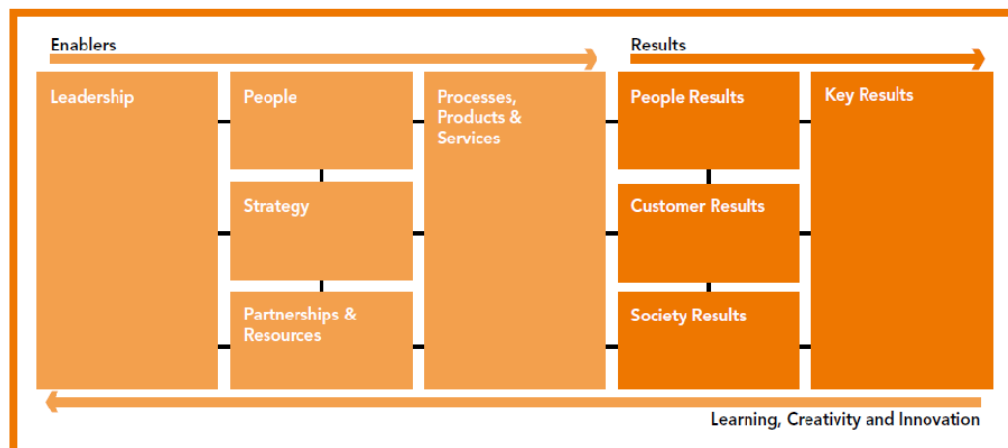
Figure 21, The EFQM model
(http://www.efqm.org/en/tabid/132/default.aspx, Nov. 2010)

The model distinguishes between 9 assessment areas, structured in the enabler area on the left side and the area of results on the right. The size of the rectangular displays roughly the importance of the criteria reflected in the maximum scores achievable in that particular discipline. The arrows on the top indicates the organization set up (enablers) leading to the results. The bottom arrow of the figure indicates the feedback loop, learning and improvement approach of the model.

EFQM version 2010
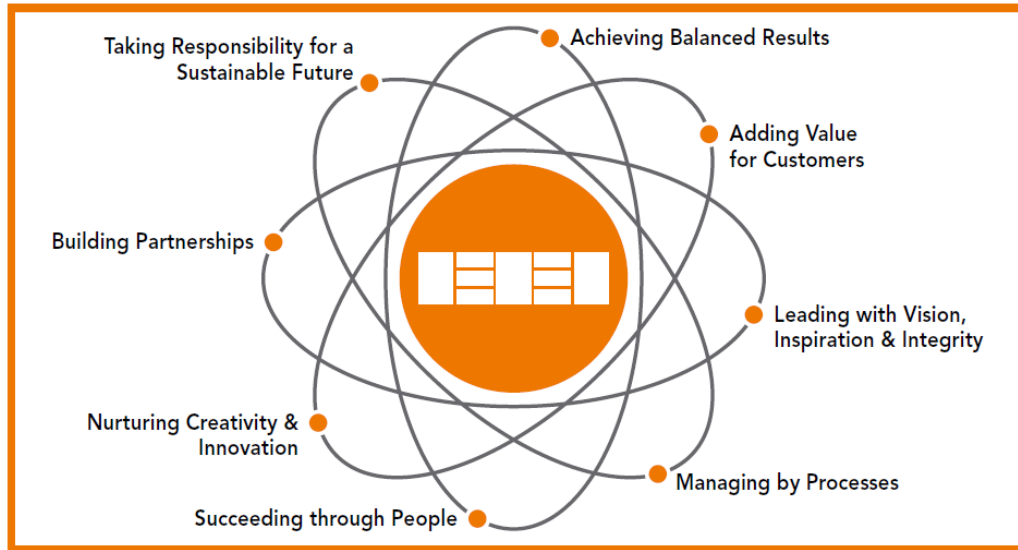
The Fundamental Concepts of Excellence, listed below, are the foundation for achieving sustainable excellence for any organization and are the basis of an excellent organizational culture. They also serve as a common language for top management.

Achieving Balanced Results
    Excellent organizations plan and achieve a balanced set of results that meet the short and long term needs of their stakeholders and, where relevant, exceed them.
Adding Value for Customers
    Excellent organizations strive to innovate and create value for their customers by understanding and anticipating their needs and expectations.
Leading with Vision, Inspiration and Integrity
    Excellent organizations have leaders who shape the future and make it happen, acting as role models for its values and ethics.
Managing by Processes
    Excellent organizations are managed through structured and strategically aligned processes.
Succeeding through People
    Excellent organizations value their people and create a culture of empowerment for the balanced achievement of organizational and personal goals
Nurturing Creativity and Innovation
    Excellent organizations generate increased value and levels of performance through systematic innovation.

Building Partnerships
Excellent organizations seek, develop and maintain trusting relationships with various partners to ensure mutual success.
Taking Responsibility for a Sustainable Future
Excellent organizations strive for economic, social and ecological sustainability.

(http://www.bqf.org.uk/performance-improvement/fundamental-concepts, Nov.2010)

Assessment guidelines

The process areas are assessed with the RADAR methodology. RADAR is the abbreviation of:

Results
Approach
Deployment
Assessment and
Review

These criteria are evaluated for each process area and a weighted summary is calculated. For each of the 9 assessment areas the maximum reachable score is defined, the sum of all is 1000 points.

Awarding principles

Organization may apply for the EFQM Excellence award. Based on a submission document the organization will be assessed by a qualified team. There is a 3 star, 4 star and 5 star award, depending on the scoring result from the assessment team. The minimum score to be awarded is 300 according the EFQM scoring scheme.

Summary

Norm models have their focus on system compliance while the EFQM model assesses the company from a holistic point of view. The assessment methodology request answers on both the set up of a process and the deployment. An organization may apply for the EFQM Excellence award.

3.3.3   Process Survey tools (PST) from Philips

Method background, history:

> *A Philips survey gives a team a tool to assess their business process and develop an improvement plan based on their assessment. The team assesses that need to be in place in order to raise process performance on a ten-step scale, from basic to world class performance.*
>
> *Philips has found a process survey tool to be a powerful tool because step description indicates what should be done to reach the next level and can readily be translated into a specific improvement plan. The maturity profile indicates weak and strong areas and suggests improvement priorities.*
> *The maturity profile enables sharing of best practice through comparison with other processes and other units*
> <div align="right">(Okland John S.2003, p.462)</div>
>
> *It helps to improve your areas for improvement related to a certain defined key process area*
> *The tool gives you tips to improve your operation, but also leaves you room for to set up own priorities where to put higher focus.*
> *Defined performance indicators can be transparently linked to the PST elements.*
> *It helps to further strengthen your continuous improvement activities*
> *Being a standardized tool, you can compare yourself with others.*

(http://www.eipm.org/networking/confannuelle/conf2006/presentations/PDF/JVM_
      PST%20EFIM%20Geneva%20December%207th%202006vs1.pdf, Jan.2011)

Assessment guidelines

Process Survey Tools (PST) are maturity grids for specific processes or functions. PST's helps to assess the maturity of a process or function and give clear indications on how to improve to reach next level of maturity. Each process is broken down into a number of "elements" or sub processes that make up the entire process. Typically there are 10 to 15 elements in each of the PST processes.
For each of the elements, a maturity scale has been created – ten levels of maturity starting from basic in step 1 and culminating in world class performance in step 10. By assessing their position against the maturity scales for each of the elements, organizations can establish a "maturity profile" for a particular

process and gain an insight into the steps they need to take to move in the direction of world class. The procedure clearly provides a basis for benchmarking process with others within or outside the organization

The level description in the elements are based on various sources and Philips own experience.
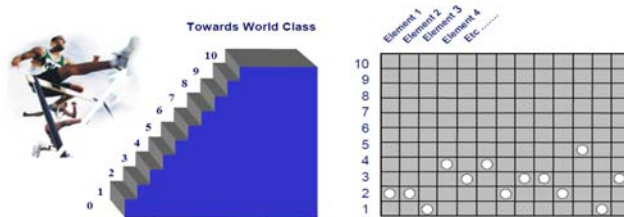
Figure 22, Philips process survey tools

(http://ww1.efqm.org/en/PdfResources/teaser-PSTfacility180609.pdf, Dec. 2010)

This figure illustrates the basic principle of the tool, the stair to reach world class level. The right diagram shows an example of the outcome after an assessment. In the matrix the maturity level of the different elements can be seen.

Philips has defined the following maturity levels:

scale   0:   informal organisation
scales 1 –3:   functional organisation with focus on transaction management
scales 4 – 6:   process oriented organisation with focus on risk management and control
scales 7 – 10:   organisation focused on integral business management

For the following key process areas Philips has developed a PST:

Manufactoring process management
Marketin and sales
Finance
Facility management process
Purchasing process management
Supply chain managenet
Human resource management

(http://www.efqm.org/en/PdfResources/EFQMcatalogue.pdf, Jan. 2011)

Awarding principles

Not applicable

Summary

The PST supports the EFQM model by a process improvement model for specific (Philips) processes. This model has a 10 level maturity scale, the assessment scope are individual processes. Based on the assessed maturity level an organization can develop an improvement plan to reach the next level. Within a company the model can be used to benchmark businesses and to share best practice.

3.3.4   Theory of constraints (TOC)

Method background, history

> *Theory of Constraints is an overall management philosophy introduced by **Dr. Eliyahu M. Goldratt**. Dr.Eliyahu Moshe Goldratt (born March 31, 1948) is an Israeli physicist who became a business management guru. He is the originator of the Optimized Production Technology, the Theory of Constraints (TOC), the Thinking Processes, Drum-Buffer-Rope, Critical Chain Project Management (CCPM) and other TOC derived tools. In his 1984 book titled The Goal that is geared to help organizations continually achieve their goal. The title comes from the contention that any manageable system is limited in achieving more of its goal by a very small number of constraints, and that there is always at least one constraint. The TOC process seeks to identify the constraint and restructure the rest of the organization around it, through the use of the Five Focusing Steps.*

> (http://en.wikipedia.org/wiki/Theory_of_Constraints, Oct.2010)

Method description and structure

To introduce the TOC some basic definitions have to be made.System, system goal and managers role,

> *A system might be generally defined as a collection of interrelated, interdependent components or processes that act in concert to turn into some kind of outputs in pursuit of some goal. Systems influence, and are influenced by their environment. Obviously quality (or lack of it) doesn't exist in a vacuum. It can only be considered in the context of the system in which it resides. So, to follow Deming's line of reasoning, it's not possible to improve quality without a thorough understanding of how that system*

works. Moreover the thinking process is the subject of this book (Goldratt's Theory of Constraints) provides a solid foundation of understanding of the theory of knowledge: how we know what we know

Let's look at a system from a broader perspective. Why do we as human beings, create systems? In the most basic sense the answer is "To achieve a goal". Okay, if a system's purpose is to achieve some goals, who gets to decide what that goal should be? Obviously the goal setter ought to be the systems owner- or owners.

The TOC rests on the admittedly somewhat rash assumption that managers and/or organizations knows what their real purpose is, what goal they are trying to achieve. Unfortunately, this isn't always the case. No manager can hope to succeed, however, without knowing three things:

- *What the ultimate goal is*
- *Where he or she currently stands in relation to that goal*
- *The magnitude and direction of the change needed to move from the status quo to where he or she wants to be (the goal)*

This might be considered "management by vector analysis". But in fact that is really what managers do. They determine the difference between what is and what should be, and they change things to eliminate that deviation.

(Dettmer H William, 1998,p 3-5)

The concept of constraints

Let's assume for a moment that you, the manager, have decided what your system's goal is and what the necessary conditions are for attaining it. Are you attaining that goal right now? If not, could you be doing better? Most people would agree that they could be doing a better job of progressing toward their goal. Okay, what keeps your system from doing better? Would it be fair to say that something is constraining your system- keeping it from realizing its maximum potential? If so, what do you think that constraining factor might be? The chances are that everybody in your organization has an opinion about it. But who is right? And how would you know if they are right? If you can successfully answer that question, you probably have a bright future ahead of you. Let's see if we can help

you with that answer. To do this, let's go back to the concept of a system.

Goldratt likens systems to chains or network of chains. Let's consider the chain as a simple system. It s goal is to transmit force from one end to the other. If you accept the idea that all systems are constrained in some way, how many constraints does the chain have? You keep increasing the force to this chain. Can you do this indefinitely? Of course not. If you do, eventually the chain will brake. But where? At what point? The chain will fail on its weakest link. How many "weakest links" does a chain have? One- only one. It will fail first only on one point, and that weakest link is the constraint that prevents the chain (system) from doing any better at achieving its goal (transmission of force)

(Dettmer H William, 1998,p 7-8)

Goldratt concluded that all other links of the chain are nonconstraints. To improve the chain it is obviously that the weakest link has to be improved. However the strength of the chain will not improve significantly as now another link will be the constraint and will fail. To improve all nonconstraints without the weakest link will not improve the chain (system).

Working on improvements of all areas of the system may result in a poor improvement progress as there is no focus on the weakest areas and the available resources are used ineffectively.

In the book another example is mentioned. Consider a manufacturing system has 5 production steps. Each step can produce x units /day. The market demand is y units. If one of the production steps output is x < y than this is the constraint. You will improve all production steps to reach that x > y to satisfy the market. However the market is the constraint now because only y units can be absorbed. The limitation is outside the internal system and has to be eliminated with different measures.

Change and the Theory of Constraints

Deming talks about "transformation", which is another way of saying "change". Goldratt's Theory of Constraints is essential about change. Applying its principles and tools answers the three basic questions about change that every manager needs to know:

What to change? (Where is the constraint?)

What to change to? (What should we do with the constraint?)
How to cause the change? (How do we implement the change?)

(Dettmer H William, 1998.p.11)

The five focusing steps of TOC

> Identify the system constraint
> Decide how to exploit the constraint
> Subordinate everything else
> Elevate the constraint
> Go back to step1, but beware of "inertia"

Assessment guidelines & Awarding principles

Not applicable for this model.

Summary

TOC is a methodology considering a complete system in a goal oriented manner. Starting from the gap analysis – current status versus target- TOC stimulates to detect the constraints in reaching the defined goals. Following the five step methods changes should be implemented to break the constraint.

3.3.5   The Shingo price

Method background, history

> *Shigeo Shingo (新郷 重夫, Shingō Shigeo?, 1909-1990), born in Saga City, Japan, was a Japanese industrial engineer who distinguished himself as one of the world's leading experts on manufacturing practices and the Toyota Production System. Shingo is known far more in the West than in Japan, as a result of his meeting Norman Bodek, an American entrepreneur and founder of Productivity Inc in the USA. In 1981 Bodek had travelled to Japan to learn about the Toyota Production System, and came across books by Shingo, who as an external consultant had been teaching Industrial Engineering courses at Toyota since 1955. Shingo had written his Study of The Toyota Production System in Japanese and had it translated, very poorly, into English in 1980. Norman Bodek took as many copies of this book as he could to the USA and arranged to translate Shingo's other books into English, eventually having his original study re-translated. Bodek also brought Shingo to lecture in the USA*

and developed one of the first Western lean manufacturing consultancy practices with Shingo's support.

The myth prevails that Shingo invented the Toyota Production System but he did document the system and added two words to the Japanese and English languages— Poka-yoke (mistake-proofing, not 'fool-proofing', which Shingo rejected as a term) and single-minute exchange of dies (SMED). In 1988, Utah State University recognized Dr. Shingo for his lifetime accomplishments and created the Shingo Prize that recognizes world-class, lean organizations and operational excellence.

(http://en.wikipedia.org/wiki/Shigeo_Shingo, Nov.2010)

Method description and structure

The Shingo model supports an organization to reach Operational Excellence. The model is based on the lean principals [Toyota Production System].

The Shingo principles are shown in two figures:
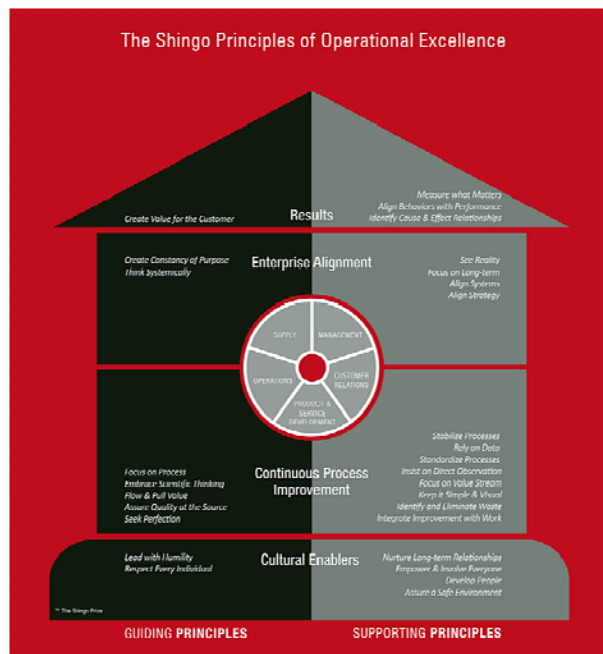
Figure 23, The house of Shingo

(The Shingo Price May, 2010, page 3)

This figure shows the principals of operational excellence and the power of balancing effort across all dimensions is shown. On

the left side the 10 guiding principles are mentioned, the right side indicates the supporting principles. Vertically the house is structured in the 4 dimensions of the model: Cultural enablers, Continuous process improvement, Enterprise Alignment and Results.

Figure 24, The Shingo diamond

<div style="text-align: right">(The Shingo Price May, 2010, page 3)</div>

This figure – the diamond – represents the transformation process for embedding the principles of operational excellence into the organizational culture.

The Shingo Principles of Operational Excellence

1	Respect every individual
2	Lead with humility
3	Seek perfection
4	Assure quality at the source
5	Flow and pull value
6	Embrace Scientific Thinking
7	Focus on process
8	Think systemically
9	Create constancy of purpose
10	Create value for the customer

(http://www.shingoprize.org/htm/about-us/model-guidelines, Nov.2010)

The model is structured as follows:

	Dimension		Belongs to principles
1	Cultural enablers	1	Respect every individual
		2	Lead with humility
2	Continuous process improvement	3	Seek perfection
		4	Assure quality at the source
		5	Flow and pull value
		6	Embrace scientific thinking
		7	Focus on process
3	Enterprise alignment	8	Think systematically
		9	Create constancy of purpose
4	Results	10	Create value for customer

Table 5, Shingo; relation dimensions-principles

Assessment guidelines

Each Dimension has to be evaluated based on a list of systems and activities that supports the principles in the dimension on a scale from 1-5. Each number represents a percentage of the maximum score (see table below), reachable at this dimension. To align the scoring the attributes of 1-5 are defend in detail for the dimension 1-3 (behaviour assessment scale) and the dimension 4 (result assessment scale)

	Dimension	Max points
1	Cultural enablers	150
2	Continuous process improvement	400
3	Enterprise alignment	200
4	Results	250

Table 6, Shingo; max. points per dimension

<div align="right">(The Shingo Price May, 2010, p. 31)</div>

Awarding principles

An organization unit may apply for the "Shingo Prize" An award can be achieved on three levels:

> Shingo bronze medallion
> Shingo silver medallion
> The Shingo Prize

Normally an organization should have a maturity of minimum three years. Based on the achievement report, prepared by the

organization, a site visit assessment will be scheduled. The handover of the awards takes place at the Shingo Prize International Conference.

Summary

The Shingo model forces the balancing of the 10 guiding principles to move towards operational excellence. All aspects and measures of an organization have to be verified on consistency with the guiding principles. However there is no precise definition of operational excellence, the systems and activities to fulfil the guiding principles may vary from organization to organization. Organizations may apply for the Shingo Prize.

4 Supplier Quality Requirements (SQR)

4.1 Main purpose of SQR

Definition:

If a supplier in the supply chain wants to deliver a product he has to respect and agree with the Supplier Quality Requirements (SQR) of the customer.

The structure in the automotive supply chain is clearly defined starting with the OEM← Tier1← Tier2← ....Tier n supplier. The supplier quality requirements as defined by the OEM's are translated into quality requirements of the Tier 1 and so forth. From the nature of this structure it is obviously that each player in this chain might ask for some "quality" reserve of the product or service he purchase. From the contractual point of view the business relation is always between the direct partners in the chain, this is valid for the technical as well as supplier quality requirements.

4.2 Design & Concept of SQR

The idea behind the SQR's is to provide existing and potential new suppliers with a general valid document where customer requirements such as:

- Supplier qualification
- Supplier audit process
- Prototype requirements
- Document management
- Product validation and verification
- Quality planning for project and production
- Quality targets
- Definition on product repair
- Change management
- Complaints handling
- Escalation process
- Supplier performance rating

are defined. This document is part or an attachment to the general purchasing contract. The document normally comprise the total product life cycle, the defined requirements are very much determined by the OEM. The size of the considered SQR documents within this Master Thesis various from 11 to 70 pages.(incl. templates and checklist)

4.3 Availability and validity of SQR

Major Tier's have their general valid supplier quality requirements published either on their Web application or offer the document on request. In the delivery contract normally there is a clause that the SQR, with a link to this document, is valid and mandatory however the valid version is not mentioned in most of the cases. This has the risk of possible changes of the SQR without notice to the supplier who has to satisfy the changed requirements.

4.4 Specific automotive quality requirements

Several influencing factors determine the characteristic of the automotive business:

- Consumer quality expectation
- Modules/systems with safety relevance
- The high numbers of components used for a car
- The low stock level in the supply chain
- Platform designs leads to multiple use of components/modules/systems
- High number of products in the market
- Global distribution of products
- It is a competitive market

These demands from the automotive market on the one side and the requirements from the automotive quality systems on the other side supplemented by specific customer company requirements leads to the SQR as described hereafter in detail.

The requirements can be divided into the following main sections
Project phase; ending with SOP (start of production)
Emphasis on the project management and product creation process as well as design verification and product validation
Serial production phase; In this phase main focus is given to productivity, quality complaints handing and change management of product and processes.
Spare parts production; ending with EOP (end of production)
Focus on long term availability of product, special packing, low order size.

4.5   Detailed analysis of SQR

This analysis is performed on the example of Webasto, Brose, Arvin Meritor (all Tier1) and John Deere (OEM)

Only the part related to process management and quality management system was considered in the detailed analysis of the SQR's.

For the detailed analysis see Appendix 5, Mapping of quality requirement specification.

4.6   Summary and conclusion of SQR's

The quality and process requirements defined in the SQR's of the considered Tier 1's and the selected OEM are very similar. The adherence to the respective norms is obviously.
For the project phase several items are related to the robustness of the design and product reliability. All the customers refer to the PPAP as the central document in the project phase and the detailed requirements are in line with those defined in the PPAP. There is a clear request for continuous improvement of product and processes. For the evaluation of the supplier qualification customers has a structured process established including on site audits with individual assessment tools. The supplier performance is monitored by defined evaluation systems. The measurement criteria are 0km ppm, delivery performance, responsiveness, complaints handling. John Deere has the contribution to the partnership, technical competence and cost reduction management as further criteria defined.

The timely handling of non conformities and remedies to deliver defect free products has high importance in the specifications.

In summary a defined, deployed, certified and continuously improved quality and process management system is a mandatory prerequisite to approach the automotive supply business sustainably and to create the necessary work structure to satisfy customer expectation.

5 Continuous process improvement in the Automotive Business

5.1 Introduction

This chapter conclude on the literature study forming the basis for the development of the Automotive Business Management Model and the main contribution of this Master thesis:

The Automotive Process Maturity Assessment (APMA).

Within this Master Thesis the APMA for the business creation process with three process areas and the quality management system with four process areas are developed in detail.

5.2 Automotive Business Management Model
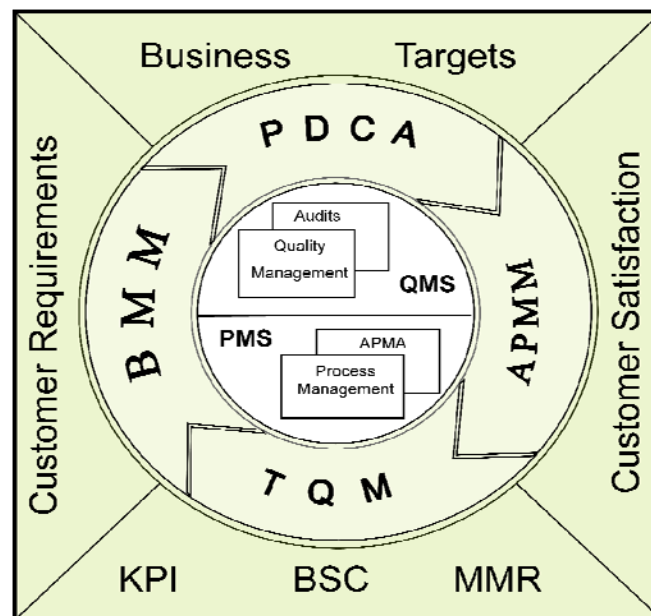
Figure 25, Business Process Model

This high level business management model can be used to set up a comprehensive automotive business management system. The **Q**uality **M**anagement **S**ystem (QMS) and the **P**rocess **M**anagement **S**ystem (PMS) built the heart of the system with related assessment methods. These are the **A**utomotive **P**rocess **M**aturity **A**ssessment (APMA) developed within this Master Thesis for the Process Management and quality audits for the Quality Management. The target of the next layer, illustrated in the

concentric cycles around the QMS and PMS of this model, is to integrate the maturity models under the Deming- **P**lan, **D**o, **C**heck, **A**ct- approach. The never ending improvement cycle is symbolised by the arrows. These Maturity models are the **B**usiness **M**aturity **M**odel (e.g. EFQM) covering the total business performance of an enterprise and the **A**utomotive **P**rocess **M**aturity **M**odel (APMM) with specific requirements as demanded of the automotive supply business. The APMM supports the process assessment area of the BMM with these specific requirements. **T**otal **Q**uality **M**anagement (TQM) is the framework for excellent performance through the four P's:Planning; People; Processes→ Performance and the three C's:Culture, Communication and Commitment.(Oakland S.J; TQM;p.27)

The envelope of this model represents the satisfaction of customer requirements and the business targets fulfilment. The critical success factors are defined as a basket of **K**ey **P**erformance **I**ndicators (KPI) with associated targets following the **B**alances **S**core **C**ard systematic. The methodology of **M**anagement **R**eview (MR) is a mandatory, inherent part of the QMS to evaluate the effectiveness of the system itself.

5.3   Evaluation and conclusion on input data

Norms and standards are the basis to set up a quality management system. Process definition and management are requirements of the considered norms. The ISO 9000 family is designed for general purpose; VDA and TS 16949 are specific for the automotive business. TS 16949 is the most common standard the automotive supply business is certified. Both the ISO 9004 and the ISO 15504 has the focus on process improvement, the ISO 9004 on general level, the ISO 15504 requires a reference model. The German automobile industry agreed to use the ISO 12207 as the reference model. The combination with the ISO 15504 is called Automotive Spice and covers mainly the SW process requirements.

Business process management includes the process design and set up of an organization. The process model, the structure of process and performance measurement has a common understanding in the specialist literature. The success of a enterprise is very much depending on the ability and persistence of the organisation to realize a transparent, systematic concept of core business processes derived from and in accordance with the vision and strategy. The critical success factors monitored with the systematic of the balanced score card are the driving forces to steer the business.

The Assessment and improvement models as evaluated within this Master Thesis have basically all the same approach. They differ in the assessment methodology and the used references and the degree of evaluation.
Some of them can be used generally (CMMI,EFQM,Shingo) others are business specific designed (PST, Spice, CMM) .

The quality requirements of the customer are summarized in the SQR documents and covers the whole product life cycle. The requirements are specific and very much common. Attention is given to the supplier qualification and evaluation.

5.4 Development of an Automotive Process Maturity Model

The idea behind the Automotive Process Maturity Model is to realize a tool to support the customer requirements and the business targets. The approach is to combine the advantages of existing improvement models with further development. The model should be specific (where appropriate) for the automotive business process management and enables the user to create a concrete improvement plan to reach the next higher maturity levels. The user should be guided by the tool to evaluate the existing maturity of the processes within the process landscape. Furthermore the tool should help to detect the constraints for the reason to be on the current level. By the step to step definition towards -world class performance- the tool should give advice about the improvement steps to move one level higher. This model should help the management of a company to set the right, effective improvement measures in order to strive for business excellence.
The condition for this model is an existing and implemented process management system where the basic elements of process management, as described in chapter *Business Process Management*, are followed. Emphasis on the results of the supplier quality requirements is given during the development of the model content definition.

5.5　Development of an Automotive Process Maturity Assessment

The methodology for the process maturity assessment as developed in the course of this master thesis built on existing tools and combination of tools in order to create a new, more effective and comprehensive assessment schematic.

The introduction to each process area is the ultimate **business goal** of the process. This is further explained and interpreted in the part **explanation**.

A set of **key performance indicators** (KPI) with related targets enables the user to design an appropriate performance measurement system. This performance indicators can be used to design a balanced score card as described in Figure 17, Balanced Sore Card.

For the understanding of the context to other processes the key requirements of the process in focus to these process areas are addressed in the part: **relation to other processes**.

To acquire an effective improvement action list the key questions derived from the Theory of constraints are mentioned under the topic: **Improvement planning**

The answer on these questions should help the organization to decide on the improvement activities towards the next step.

Maturity level definition

Where appropriate the maturity level definition takes into consideration the requirements of the automotive business and in particular the automotive supplier business. The systematic of maturity levels is equal for all business processes within this model. The entry level defines a situation of undefined processes and/or no evidence of documentation. On a scale from 1 to 10 the requirements to the organization are defined to enter a higher level on the maturity ladder. The condition to reach level 2 is an existing and deployed process management and is an equal requirement for all processes. The top demanding level ⑩ is very much driven by the aim of world class performance.

World class performance can be seen as a performance level defined as the benchmark of a particular process area. World class performance is not an absolute level. World class performance means do be the best in all processes and services offered.

A level can only be successfully reached if the criteria for the lower levels are fully satisfied.

Within this Master Thesis the process maturity assessments for the business creation process with three process areas and the quality management system with four process areas are

developed in detail. Other key processes with their process areas can be added to complete this automotive process maturity model.

Business Process	Process Area
Business Creation Process	Acquisition of new customer
	Customer base management
	Product portfolio management
Quality Management	Failure prevention
	Product release
	Failure management
	Continuous improvement

Table 7, Business Process and Process Area

5.6   APMA for Business Creation Process
5.6.1   Process area: Acquisition of new Customers

Business goal:

Business objectives are supported by new customer acquisition.
The process is well managed and reviewed.
Explanation:
The acquisition of new customer is derived from the business
objectives. The customer/ product portfolio is defined and
regularly reviewed. The criteria's for new customers are
documented and forms the decision basis. New customers are the
result of the process.

Key performance indicators:

KPI: Acquisition of new customer
  Target: number of new Customer/ number of planned new
                    customer
  Target: Criteria's for acquisitions are reviewed once a
                    year
KPI: Acquisition process
  Target: Needed effort/ planned effort
  Target: Acquisition process review is done once a year
KPI: Market Analysis
  Target: market data are available and updated according
                    time schedule

Interface to other process areas:

Customer base
Management→ Is the Acquisition strategy aligned with the
                strategy of customer base management)

HRM→   is the organization be prepared for new customer

Development→ Are the appropriate resources for new customer
                projects planned)

Improvement planning:
What is the root cause to be on this maturity level?
What are the constraints to reach one level higher?
What are the benefits for the organization to be one level
higher?
What concrete improvement measures are planned to reach the
next level?
What concrete improvement measures are needed to improve a
given KPI?

APMA for Business Creation Process
Process area: Acquisition of new Customers

Level	CRITERION
0	New customer "happens", there is no structure in place to acquire new customers
1	A process for customer acquiring is defined, documented, process owner is nominated, key performance indicators are selected and the process is deployed and regularly reviewed
2	The criteria to approach a new customer are defined; the criteria are distinguished in mandatory and desirable targets.
3	Market research data are available to identify potential new business opportunities (customer/region/product)
4	The acquisition effort is planned, budgeted and controlled
5	Potential new customers are selected based on defined criteria's in line with business strategy and objectives
6	The potential impact on the organization and existing customers are considered for the acquisition
7	New customers are assessed on their risk not to realize the expected business target. This is based on defined criteria
8	Lifetime value and long term impact of potential new customers are known and in accordance with business objectives
9	Decision hierarchy to approach and release new customer is defined and executed
10	Acquisition strategy is regularly reviewed based on updated market data and adopted accordingly. The acquisition strategy is regularly aligned with the business strategy.

APMA for Business Creation Process
5.6.2   Process area: Customer base management

Business goal:
Maintain and increase the business volume with existing customer base. The customer base is actively managed.

Explanation:

The proactive management of the existing customer portfolio is of paramount importance to sustain in the business and to reach the business ambitions. Proactive means to have a fact based clear and comprehensive rating of each customer and the expected business potential. For each customer a strategy is defined, communicated and regularly reviewed.

Key performance indicators:
KPI: Customer satisfaction
  Target: satisfaction level
  Target: satisfaction measurement according time
                schedule
  Target: results and improvement activities are
                communicated with the customer once a year
KPI: Customer base management
  Target: strategy per customer defined and reviewed
  Target: Current CB/ Planned CB
KPI: process managed
  Target: process review performed once a year

Interface to other process areas:
Acquisition→   Does the acquisition strategy respect the
               customer portfolio management?
HRM →   Are the dedicated employees sufficiently trained
               in CRM process and tools?
Industry→   does the industrial strategy built on the expected
               demand resulting from the customer base
               management?
Development→ Are the required resources for product design
               maintenance available

Improvement planning:
What is the root cause to be on this maturity level?
What are the constraints to reach one level higher?
What are the benefits for the organization to be one level higher?
What concrete improvement measures are planned to reach the next level?
What concrete improvement measures are needed to improve a given KPI?

APMA for Business Creation Process
Process area: Customer base management

Level	CRITERION
0	There are no structural activities in places to manage the customer base.
1	A process for customer base management is defined, documented, process owner is nominated, key performance indicators are selected and the process is deployed and regularly reviewed
2	Criteria to judge the value and the impact of a customer to the enterprise business targets are defined
3	Customer satisfaction measurements are performed regularly, improvement plans agreed and monitored
4	Improvement plans and results are communicated with the customer
5	The customers market environment and business ambitions are known, a system to get change information is in place
6	The business plans of the customer are aligned with own generated business figures
7	Recurrent meetings with customer to align the strategy are executed
8	The enterprise has a contingency plan for the key customers in case of unexpected events.
9	A customer base strategy is available regularly reviewed and the basis for decisions
10	Organization has a profound knowledge of the market, of customer behavior and ambitions. Organization is in the position to set measures anticipating customer decisions.

APMA for Business Creation Process
5.6.3   Process area: Product portfolio management

Business goal:
The product portfolio contributes efficiently to the business objectives. The product portfolio has to be aligned with the capability and the strategy of the enterprise.

Explanation:
The product strategy is derived from the business strategy and has an important leverage on the industrial strategy. The product strategy should reflect the core competences and process knowledge of an enterprise. The product life cycle, the product mix and the product evolution has to be considered in the development of the strategy and the derived roadmap.

Key performance indicators:

KPI: Product portfolio management
   Target: key products are identified and documented
   Target: effort spent/effort planned for product
                maintenance
   Target: Product roadmap defined and regularly reviewed
KPI: Business results
   Target: financial contribution per product is known
   Target: product life cycle /product group

Interface to other process areas:

Customer base
management → Do we have the right customers to
                sell our products?
HRM →   Do we have the right people with the right
                knowledge for product maintenance and
                evolution?
Development→ Does the development strategy include product
                maintenance and product evolution?
Purchasing→   Does the supplier and component roadmap takes
                the demand for the product portfolio into
                consideration?

Improvement planning:

What is the root cause to be on this maturity level?
What are the constraints to reach one level higher?
What are the benefits for the organization to be one level higher?
What concrete improvement measures are planned to reach the next level?
What concrete improvement measures are needed to improve a given KPI?

APMA for Business Creation Process
Process area: Product portfolio management

Level	CRITERION
0	There is no product portfolio management in place, no limitation are defined, only reactive behaviour on customer requests
1	A process for product portfolio management is defined, documented, process owner is nominated, key performance indicators selected, the process is deployed and regularly reviewed, The output is a product roadmap
2	The product life cycle of the current portfolio is estimated and documented.
3	The contribution of the each product/family to the business objectives are known
4	Per product/product family there is defined product development plan existing;
5	The scope of products is defined, derived from the business and marketing strategy
6	A benchmark process is defined; the product portfolio is regularly evaluated against benchmark information
7	The industrial and purchasing roadmap is considered by the definition of the product strategy
8	A product portfolio strategy exists and is regularly reviewed. The strategy is built on product life cycle, contribution per product, market development.
9	The product strategy is part of business review meetings with the customer; the particular part of the product roadmap is reviewed with the customer
10	The product portfolio strategy is aligned with the business strategy in particular with customer base strategy and the strategy for the acquisition of new customers.

5.7 APMA for Quality Management
5.7.1 Process area: Failure prevention

Business goal:
Gain and sustain customer loyalty. Failure prevention is less expensive than failure abolishment. The development effort is on a competitive level.

Explanation:
The wise saying: "Do it right the first time" is the background for this set up. The organization should have a systematic in place to translate customer specification into design criteria. Design guidelines and defined robust processes are the basis for a robust design. Early sample test should help to limit the design loops. The organization needs to master the appropriate quality tools common used in the automotive business.

Key performance indicators:

KPI: Design standards managed
  Target: Number of design loops due to design failures
  Target: Number of test loops/ planned test loops
  Target: Number of identified problems during release testing
KPI: Knowledge on quality tools
  Target: executed trainings/planned trainings
  Target: Training hours/ "quality" employee
KPI: process managed
  Target: process review performed once a year

Interface to other process areas:

Development→ Does the engineering community regularly updates their knowledge on design rules.
HRM → Are the organization in general and dedicated employees specifically trained in quality tools?
Industry→ Are robust processes defined and considered in the industrial strategy
Quality management→ Does the quality management has a closed loop to the development

Improvement planning:
What is the root cause to be on this maturity level?
What are the constraints to reach one level higher?
What are the benefits for the organization to be one level higher?
What concrete improvement measures are planned to reach the next level?
What concrete improvement measures are needed to improve a given KPI?

APMA for Quality Management
Process area: Failure prevention

Level	CRITERION
0	Failure prevention is not based on a structural process; design quality is mainly dependent on the maturity of engineers.
1	A process for failure prevention is defined, documented, process owner is nominated, key performance indicators are selected and the process is deployed and regularly reviewed.
2	Project management determines upfront in a project the applicable methods to create a robust design.
3	The following methods are known in the organization and regularly applied: DFMA, DMU, DoE, FMEA, FTA, Producibility study, Poke Yoke, QFD, Regressions analysis, SPC, SWOT, TRIZ,ANOVA
4	Engineers in development, testing and quality department are regularly trained on quality tools.
5	The organization has a system in place to retrieve known problems and solutions in order to avoid recurrence.
6	The organization has a cross functional, structured process in place to communicate quality problems and solutions.
7	The organization follows a systematic to translate customer requirements into design specification. Requirements engineering is one of the key activities in the project.
8	The organization considers Halt and Hass testing to improve design quality and to reduce development effort. The boundaries of the design are known and documented.
9	The organization has a system in place to gain sound understanding of the product function, operation environment, borderline conditions and function for use.
10	All developed products pass the design verification and product validation without subsequent improvement. Design costs are on a competitive level.

APMA for Quality Management
5.7.2   Process area: Product release

Business goal:
Products with zero defects are delivered to enhance customer loyalty. The cost for non conformity is as low as planned.

Explanation:
The product release process is carefully planned and documented. The test specification considers customer requirements, experience of previous projects and results of failure analysis. The test specification is agreed with the customer. The organization keeps the knowledge on test technologies up to date. New products/functionalities, new components and new technologies requires special attention.

Key performance indicators:

KPI: **Product quality**
   Target: number of reported failures potentially detectable during release
   Target: number of release loops needed per product
   Target: test effort consumed/ test effort planned
KPI: **Customer approval**
   Target: PPAP acceptance rate by customer
   Target: PPAP delivery time/planned time
   Target: releases with conditions/ total number of releases
KPI: **Process management**
   Target: Process review performed according schedule

Interface to other process areas:
Development→ Does development consistently respect the design guide lines?
HRM →   Are the dedicated employees regular trained on PPAP, specific customer requirements and testing technologies?
Industry→   Is the industry timely involved in the product/process design?

Improvement planning:
What is the root cause to be on this maturity level?
What are the constraints to reach one level higher?
What are the benefits for the organization to be one level higher?
What concrete improvement measures are planned to reach the next level?
What concrete improvement measures are needed to improve a given KPI?

APMA for Business Creation Process
Process area: Product release

Level	CRITERION
0	Release testing is not planned; test methods are selected by chance.
1	A process for customer base management is defined, documented, process owner is nominated, key performance indicators are selected and the process is deployed and regularly reviewed
2	The test specification is communicated and agreed with the customer.
3	The test methods are regularly reviewed on the capability for the required test application.
4	Reproducibility of test execution and results has to be realized. Whenever possible test execution has to be automated and documented
5	Are detected problems during release process sufficiently analyzed, the root cause detected, appropriate systematic measures implemented and communicated.
6	PPAP documents are complete and delivered in time. The customer can approve the majority of products right away.
7	The organization has a system in place to modify the test process and specification based on the experience gained through failure analysis and customer feedback
8	The organization regularly review the test methods and investigate the state of the art technologies
9	The organization performs tests beyond the agreed test specification to gain knowledge on the design boundaries of the product. The results are used for further design improvement to increase the robustness
10	The delivered quality as perceived by the customer is rated as outstanding and one of the key criteria to be classified as first choice supplier

5.7.3   Process area: Failure Management

Business goal:
Professional complaints management increase customer loyalty.
Non conformance cost should be as low as possible.

Explanation:
Although zero defect is the ultimate goal, failure happens.
Professional complaints management is the condition to solve
issues and to limit the potential effect in the market to a
minimum. The applicable tools and methods for complaints
handling and failure analyze are known, people involved are
trained. Accurate records and consistent follow up are part of the
process definition. A closed feedback loop to design and testing
department is established.

Key performance indicators:

KPI:	**Failure Management**
Target:	throughput time per complaint
Target:	compliance with target time per 8D section
Target:	total cost of non compliance
Target:	total cost of non compliance/ sales
KPI:	**Knowledge management**
Target:	number of failure recurrence
Target:	number of quality meetings/ planned quality meetings
KPI:	**Process management**
Target:	process review performed once a year

Interface to other process areas:

Purchasing→   Does the supplier rating take into consideration
component quality and complaint support

HRM →   Are dedicated employees sufficiently trained in
complaints tools and behaviour?

Industry→   Does the industry treat failure management as a
core competence staffed accordingly?

Development, Testing

Quality→   Is there a systematic feedback process in place?

Improvement planning:
What is the root cause to be on this maturity level?
What are the constraints to reach one level higher?
What are the benefits for the organization to be one level
higher?
What concrete improvement measures are planned to reach the
next level?
What concrete improvement measures are needed to improve a
given KPI?

APMA for Quality Management
Process area: Failure Management

Level	CRITERION
0	Failure management is not in place, complaints are handled ad hoc, problem solving not monitored
1	A process for failure management is defined, documented, process owner is nominated, key performance indicators are selected and the process is deployed and regularly reviewed
2	The organization has a system in place to record and to follow up quality complaints. Dedicated employees and management have access to this system. The system warns if target dates are closed to exceed.
3	8D methodology and analysis process is known. Regular training is performed, methods are continuously improved.
4	Organization has sufficient, qualified employees to be prepared for complaint handling Employees performing product analyse are trained on specific product and application know how
5	Customer receives frequently and regular update on the progress of the complaints execution.
6	There is a system in place to feedback the results of failure analysis for FMEA/FTA improvement.
7	For each customer/product combination there is a quality reporting in place. The quality data are aligned with customer view.
8	Regular meetings are scheduled with customer to review the complaints management and to develop improvement plans.
9	Customer satisfaction measurement includes explicit inquiry on the customer appraisal on the performance of this process.
10	The established process for failure management results in strong conviction of the customer. All levels of the organization pay highest attention to failure management. The organization can consistently prove their self learning attitude.

APMA for Quality Management
5.7.4   Process area: Continuous Improvement

Business goal:
Competitive cost structure and quality enhance customer loyalty.
Continuous learning becomes an asset of the organization.

Explanation:
Failures are an opportunity to learn and to improve processes,
design, technologies or components. Effective failure remedy
should have the highest priority while failure prevention is the
ultimate goal of the organization. Improvement activities should
result in comprehensive, sustainable measures and be a dominant
characteristic of the organization attitude. A professional,
learning organization can be measured by the recurrence rate.

Key performance indicators:

KPI: Continuous improvement
   Target: recurrence rate/total failure rate
   Target: executed CIP meetings/planned meetings
   Target:
KPI: Knowledge sharing
   Target: Access counter to a system
   Target: Number of people participating in knowledge
                 sharing meetings/ planned
KPI: Continuous process improvement
   Target: Process review according plan

Interface to other process areas:

All areas→   Does each unit have a transparent, deployed and
                 visible improvement plan in place?
HRM →   Are the dedicated employees sufficiently trained
                 in problem solving methodologies and tools?
Project
Management→ Does the project management process require the
                 realization of existing "lessons learned"?
Process
Management→ Does the process manager (team) regularly review
                 the "learning's" to identify potential process
                 improvements.

Improvement planning:
What is the root cause to be on this maturity level?
What are the constraints to reach one level higher?
What are the benefits for the organization to be one level
higher?
What concrete improvement measures are planned to reach the
next level?
What concrete improvement measures are needed to improve a
given KPI?

APMA for Quality Management
Process area: Continuous improvement

Level	CRITERION
0	Enterprise doesn't have processes in place to steer a structured improvement process. Recurrence of failures or problems effect customer relationship.
1	A process for continuous improvement is defined, documented, process owner is nominated, key performance indicators are selected and the process is deployed and regularly reviewed
2	Root cause and improvement measures are recorded in an appropriate system. The organization has access to this system
3	Techniques for failure analysis and problem solving are known, applied and regular trained. (Deming cycle PDCA, Six Sigma, Ishikawa, 5 Why......)
4	Closing of improvement activities can only be done after the effectiveness of a measure is verified
5	Knowledge of root cause and improvement measure is made available to all employees. A system is in place to access this information effectively
6	New projects are obliged to access the " Lessons learned" information prior to start the development phase
7	The organization can proof that CIP activities are communicated to the concerned customer
8	Beside the information access via a system the organization performs regular meeting with relevant employees to distribute the gained experience
9	The organization has an information structure in place to share " lessons learned" actively cross organization
10	Continuous improvement is recognized as a proactive process and as an essential element of the company identity. Outstanding performance in CIP is promoted and celebrated in the organization.

6 CONCLUSION

This part of the conclusion is structured according the research questions defined in 1.3

Does the QMS contribute to satisfy customer requirements?

Yes, as mentioned in the conclusion on the SQR an established and certified quality management system like TS 16949 is a prerequisite to sustain in the automotive supply business.

To which extent does the QMS contribute to satisfy customer requirements?

The QMS as defined by the TS 16949 is the framework for a system including process definition. Although minimum standards have to be established as defined in the norm, this framework allows an ample scope of implementation. How far customer requirements are covered indeed is depending on the scope of implementation in the existing QMS.

Does the PMS contribute and to satisfy customer requirements?

Yes, a PMS as described in 3.2 defines the interrelated and interacting of processes. Processes are defined to transforms input to outputs. The efficiency of this transformation effects in a direct or indirect way customer satisfaction. For customer audits the PMS may be used as reference.

To which extent do the PMS contribute to satisfy customer requirements?

The PMS defines the way of working and requires performance indicators. These indicators are to a certain extent derived from customer requirements; others are related to complementary enterprise performance targets. Customer requirements not associated with defined processes may not have the right attention.

Does the QMS structurally stimulate a continuous process improvement process?

Continuous improvement is anchored in the systems however the scope of improvement is related to organisation, manufacturing processes and quality management systems. Although this implies indirect improvement of process it is not explicit addressed.

ISO 15504 has a clear scope of process improvement but mainly limited to software processes.

Does the PMS structurally stimulate a continuous process improvement process?

Yes, the PMS includes performance measurement with the aim to improve the outcome and the effectiveness of processes.

To overcome the weaknesses of existing systems in respect to process improvement and the ability to satisfy customer requirements in a broader sense the Automotive Business Management Model was developed by this Master Thesis. The methodology of APMA combines the systematic of different models resulting in an automotive specific assessment tool.

Outlook and recommendation

In the scope of this Master Thesis the APMM could not be completed for all relevant process areas to finish a comprehensive assessment tool. The author recommends applying this system to collect practical experience before questionnaires for further process areas are developed.

Closing statement

Any kind of management systems can only guide and support an organization to strive for business excellence. The important assets of an enterprise are the employees and their attitude to act as entrepreneurs in each discipline.

The executives of an enterprise are responsible to create a company culture where:
 the business targets are clearly communicated
 everyone is aware of her/his quality responsibility
 personal failures are treated in a respectful manner
 adherence to commitments is taken for granted
and the employees can be proud to be part of this enterprise.

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Webasto	(Sep. 2010), Quality Guideline for Suppliers, QW1, 14th ed., http://suppliers.webasto.de/cps/rde/xbcr/SID-0ACE1856-D29AA099/sp_de/C02_QW1_English_issue_14.pdf

Table 8 Bibliography

LISTS

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APPENDIX

1. Current Standards and Documents

Standard/ document	Title	Edition	Publication Date	Comment	MSS Type
ISO 9000:2005	Quality management systems – Fundamentals and Vocabulary	Third	2005-09-15	Preliminary work item under consideration	C
ISO 9001:2008	Quality management systems – Requirements	Fourth	2008-11-15	New edition published	A
ISO 9004:2000	Quality management systems – Guidelines for performance improvements	Second	2000-12-15	Revision in progress	B
ISO 10001:2007	Quality management – Customer satisfaction – Guidelines on codes of conduct for organizations	First	2007-01-12		C
ISO 10002:2004	Quality management – Customer satisfaction – Guidelines for complaints handling in organizations	First	2004-07-01		C
ISO 10003:2007	Quality management – Customer satisfaction – Guidelines for dispute resolution external to organizations	First	2007-01-12		C
ISO 10005:2005	Quality management - Guidelines for quality plans	Second	2005-06-01		C
ISO 10006:2003	Quality management - Guidelines for quality management in projects	Second	2003-06-15		B
ISO 10007:2003	Quality management - Guidelines for configuration management	Second	2003-06-15		C
ISO 10012:2003	Measurement management systems- Requirements for measurement processes and measuring equipment	Second	2003-04-14		B
ISO/TR 10013:2001	Guidelines for quality management system documentation	Second	2001-07-15		C
ISO 10014:2006	Quality management – Guidelines for realizing financial and economic benefits	First	2006-07-01		B
ISO 10015:1999	Quality Management: Guidelines for training	First	1999-12-15		C
ISO/TR 10017:2003	Guidance on statistical techniques for ISO 9001:2000	Second	2003-05-15		C
ISO 10019:2005	Guidelines for the selection of quality management system consultants and use of their services	First	2005-01-05		C
ISO/TS 16949:2002	Quality management systems, Automotive Suppliers, Particular requirements for the application of ISO 9001:2000	Second	2002-03-01	Amendment in progress	A
ISO 19011:2002	Guidelines on quality and/or environmental management systems auditing	First	2002-10-01	Revision in progress	C
ISO Brochure: 2008	Selection and Use of ISO 9000 - TC 176 N613R1	Second	2008-01	Online version – ISO website	C
ISO Brochure	Quality Management Principles and Guidelines on their Application - TC 176 N595	First	2000-11	Online version – ISO website	C
ISO Handbook:2002	ISO 9001 for Small Businesses - What to do: Advice from ISO/TC 176	Second	2002-07	Revision in progress	B

Appendix 1, Documents issued by ISO/TC 176

(http://www.tc176.org/pdf/N817R8DocumentStatusRepor_December2008.pdf
Oct. 2010)

Table A.1 — Self-assessment of key elements — Correlation between key elements and maturity levels

Key element	Maturity level				
	Level 1	Level 2	Level 3	Level 4	Level 5
What is the management focus? (Managing)	The focus is on products, shareholders and some customers, with only some ad hoc reactions to changes, problems and opportunities.	The focus is on customers and statutory/regulatory requirements, with some structured reaction to problems and opportunities.	The focus is on people and some additional interested parties. Processes are defined and implemented for reacting to problems and opportunities.	The focus is on balancing the needs of identified interested parties. Continual improvement is emphasized as a part of the organization's focus.	The focus is on balancing the needs of emerging interested parties. Best in class performance is set as a primary objective.
What is the leadership approach? (Managing)	The approach is reactive, and is based on top-down instructions.	The approach is reactive, and is based on decisions by managers at different levels.	The approach is proactive, and the authority to take decisions is delegated.	The approach is proactive, with high involvement of the organization's people in its decision making.	The approach is proactive and learning-oriented, with the empowerment of people at all levels.
How is it decided what is important? (Strategy & policy)	Decisions are based on informal inputs from the market and other sources.	Decisions are based on customer needs and expectations.	Decisions are based on the strategy and linked to needs and expectations of interested parties.	Decisions are based on the deployment of the strategy into operational needs and processes.	Decisions are based on the need for flexibility, agility and sustained performance.
What is needed to get results? (Resources)	Resources are managed in an ad hoc manner.	Resources are managed effectively.	Resources are managed efficiently.	Resources are managed efficiently and in a way that takes into account their individual scarcity.	The management and use of resources is planned, efficiently deployed, and satisfies the interested parties.
How are the activities organized? (Processes)	There is a non-systematic approach to the organization of activities, with only some basic working procedures or instructions in place.	Activities are organized by function, with a basic quality management system in place.	Activities are organized in a process-based quality management system that is effective and efficient, and which enables flexibility.	There is a quality management system that is effective and efficient, with good interactions between its processes, and which supports agility and improvement. The processes address the needs of identified interested parties.	There is a quality management system that supports innovation and benchmarking, and which addresses the needs and expectations of emerging, as well as identified, interested parties.

Appendix 2, Example for self assessment

(ISO 9004:2009,p83)

EFQM Excellence Model 2010 – Criteria

1a.	Leaders develop the mission, vision, values and ethics and act as role models
1b.	Leaders define, monitor, review and drive the improvement of the organisation's management system and performance.
1c.	Leaders engage with customers, partners and representatives of society
1d.	Leaders reinforce a culture of excellence with the organisation's people
1e.	Leaders ensure that the organisation is flexible and manages change effectively
2a.	Strategy is based on understanding the needs and expectations of both stakeholders and the external environment
2b.	Strategy is based on understanding internal performance and capabilities
2c.	Strategy and supporting policies are developed, reviewed and updated to ensure economic, societal and ecological sustainability
2d.	Strategy and supporting policies are communicated and deployed through plans, processes and objectives
3a.	People plans support the organisation's strategy
3b.	People's knowledge and abilities are developed
3c.	People are aligned, involved and empowered
3d.	People communicate effectively throughout the organisation
3e.	People are rewarded, recognised and cared for
4a.	Partners and suppliers are managed for sustainable benefit
4b.	Finances are managed to secure sustained success
4c.	Buildings, equipment, materials and natural resources are managed in a sustainable way.
4d.	Technology is managed to support the delivery of strategy
4e.	Information and knowledge are managed to support effective decision making and to build the organisational capability
5a.	Processes are designed, managed to optimise stakeholder value
5b.	Products and Services are developed to create optimum value for customers
5c.	Products and Services are effectively promoted and marketed
5d.	Products and Services are produced, delivered and managed
5e.	Customer relationships are managed and enhanced

Appendix 3, EFQM 2010 Criteria

Appendix 4, Selection table for preventive measure

Problem-Solving Method	Creativity Method	Determ./Implemen. of Cust. Requirements	Failure Avoidance Method	Cost Saving Potential	Process Control and Assurance	Attaining Robust	Simulation Method	Concept Phase	Product Development	Product Validation and Verification	Pre-Production Phase	Production	Product	Process	Organisation	Method and Method Objective	Reduction of external costs	Reduction of internal costs	Reduction of failures	Compliance with customer/cost targets	Compliance with function requirements	Solving of problems	Detection of failure causes	Standardisation of processes
		X	X		X			█	█	█			X	X		**DFMA (Design for Manufacture and Assembly)** — Optimisation of the design engineering and the manufacturing costs, reduction of the number of parts, of the development times and of the assembly expenditures, and the raising of quality		X	X					
		X					X	█	█				X	X		**DMU (Digital Mock Up)** — Geometrical assurance of the installation spaces through virtual installation and assembly simulation, and the reduction of the number of prototypes, samples and change costs		X	X					
X		X	X		X			█	█	█	█		X	X		**DoE (Design of Experiments)** — Practice-oriented analysis of systems using statistical test plans to reduce the test expenditure in order to achieve optimal products and processes by using the knowledge of the system behavior			X		X			
		X	X	X				█	█	█	█		X	X		**FMEA (Failure Mode and Effects Analysis)** — Identification and assessment of potential failures (occurrence, significance and detection) and determination of measures for the avoidance of failures and/or the reduction of risks	X	X	X		X		X	
X			X					█	█	█	█		X	X		**FTA (Fault Tree Analysis)** — Analysis and depiction of the logical links of component and subsystem failures, in order to show the effects of possible unwanted events and their functional interrelationships	X	X	X			X	X	
	X		X					█						X	X	**Producibility Analysis** — Systematical determination of technical, organisational and commercial requirements and risks, as well as their implementation possibilities		X			X			
		X	X	X	X			█	█	█	█		X	X		**Poka Yoke** — Avoidance of unintentional failures by people, using appropriate technical and/or organizational measures			X					X
	X	X						█	█	█			X	X	X	**QFD (Quality Function Deployment)** — Translation of the customer's voice (internal and external), i.e. wishes, requirements and needs into the manufacturer's language (product and process specification)				X	X			
X					X				█	█	█		X	X		**Regression Calculation** — The recognition and description of systematic dependencies between continuous influencing variables and target variables						X		
		X	X	X						█	█	█	X	X	X	**SPC (Statistical Process Control)** — Monitoring and control of process and product characteristics by means of statistical methods and procedures		X	X					
		X	X		X			█	█	█	█		X	X	X	**SWOT Analysis (Strengths-Weaknesses/Opportunities-Threats)** — Determination of the ACTUAL position of products and systems (strengths-weaknesses/opportunities-threats) on the market and in the competitive environment					X			
X	X	X						█	█				X	X		**TRIZ / TIPS (Theory of Inventive Problem Solving)** — Determination of innovative solutions and optimizations of existing systems through the target-oriented assignment of tasks and the resolving of contradictions						X	X	
X			X					█	█	█	█		X	X		**ANOVA – Analysis of Variance** — Detection of significant influences on measurable/continuous target variables						X		X
X			X	X					█	█	█	█	X	X	X	**8D Method** — Finding failure causes and eliminating them sustainably by means of a systematic team-oriented problem-solving process						X	X	

(VDA 14; 1st Edition 2008; p.27)

	BROSE	**ARVIN MERITOR**	**WEBASTO**	**JOHN DEERE**
Quality Targets	Brose requires a "zero error target" from its suppliers. In order to pursue this zero error target, a direct quality advance plan, implementation in production, an effective series production monitoring system, requalification and continuous improvement (CIP) are indispensable.	ArvinMeritor requires that its suppliers implement an appropriate systems and controls to ensure the 100% on-time delivery of conforming, defect free products to ArvinMeritor.	We apply a zero-defects strategy to all of our business processes.	Čpk of 1.67 being the ultimate goal for John Deere suppliers to assure a high level of defect free product.
Quality system requirements	TS 16949 Quality management system certification according ISO 14001 or validation according to EMAS is required of companies using surface processing technology (galvanizing and painting systems) Quality advance planning (QAP) using the supplier quality readiness system (SQR) or supplier has to use a quality advance plan according TS 16949 and QS 9000 (APQP)	TS 16949 Quality management system Production Part Approval Process (PPAP) Advanced Product Quality Plan (APQP) Failure Mode And Effective Analysis (FMEA) Measurement System Analysis (MSA) Statistical Process Control (SPC) according AIAG reference manual	minimum ISO 9001:2008, adjusted to the international standard ISO/TS 16949:2009, preferred are suppliers with environmental management system according ISO 14001 Advanced Product Quality Planning and Control plan /APQP) FMEA for design and process, control plan, Measurement system analysis (MSA)	JD encourage our supply chain to become compliant to the international automotive management standard ISO/TS 16949. This manual (JDS-G223) represents the minimum requirements for JD.
Reference to international standards	VDA, AIAG, FIEV, ANFIA, SMMT, IPC, MDSystem, EMAS, Din EN 10204-3.1, ISO 14001	AIAG, TS 16949, ISO 9001, ISO 14001, ELV Directive 2000/53EC	VDA, TS 16949,	TS 16949, AIAG

	BROSE	ARVIN MERITOR	WEBASTO	JOHN DEERE
Legal requirements	The supplier shall be informed of all national/international standards that impact his contract products.	comply with all applicable government statutes, regulations and standards related to motor vehicle safety and emissions (e.g. US FMVSS safety standard, 49 USC 301)	PPAP documentation requires beside others the confirmation of compliance with legal requirements.	commitment of the top management to communicate the importance of regulatory and legal requirements
Production Process Monitoring	Brose requires an effective series production monitoring system, Brose reserves the right to perform process audits regularly. the supplier must test and record the ongoing adherence to he specified values for characteristics that are important and/or critical to safety during series production	systematic suppliers manufacturing process review, Suppliers are required to meet the process capability requirements as defined in the AIAG PPAP and SPC reference manual. Capability indices has to be achieved and improved throughout production.	For CC, SC and WSC characteristics proof of preliminary process capability (see section 5.9) and monitoring of process capability during mass production (see section 7.2) is required. In the control plan process monitoring instructions and inspection plans shall be defined and used continually. Process capability shall be calculated on a regular basis. The documentation for this must be completely available.	A supplier shall determine and implement measurements necessary to monitor processes critical to customer satisfaction. Review of process monitoring techniques shall be made available to John Deere personnel upon request. This section not only applies to manufacturing processes, but also business processes that are critical to customer satisfaction
Project management process	The supplier is obligated to operate a functioning project management beginning in the planning phase of products, processes and other cross-departmental tasks.	no specific statement	The Advanced Quality Planning program covers the stages from development to mass production. It requires a cross functional team that includes all main departments such as Sales, Engineering, Production Engineering, Manufacturing, Purchasing and Quality Assurance.	An effective and structured product realization planning process shall result in the determination of: • The quality objectives for the product or service; • The need to develop specific processes, resources, facilities, and documentation; and • Verification and validation activities and the criteria for acceptability.

	BROSE	**ARVIN MERITOR**	**WEBASTO**	**JOHN DEERE**
Automotive Spice requirements	min level 2 or customer target if higher	no specific requirement	no specific requirement	no specific requirement
Continuous improvement	Brose requires a "zero error target" from its suppliers. In order to pursue this zero error target, a direct quality advance plan, implementation in production, an effective series production monitoring system, requalification and continuous improvement (CIP) are indispensable.	The supplier shall improve continually quality, delivery, cost and other service provided. The objective and targets should be established based upon (at minimum) business plans, management systems, product quality, process capability and customer satisfaction goal.	The supplier should develop specific action plans for continual improvement in processes that are most important to the customer once those processes have demonstrated stability and acceptable capability. These processes can be selected and monitored using the quality operating system (QOS).	top management commitment to continuous improvement Evidence shall demonstrate the use of data, past experience, and lessons learned to show continuous improvement of the quality management system.
Supplier audit	supplier shall assure that Brose have access to its operating facilities and systems to inspect the supplier's quality management system	ARM, an approved 3rd party representative or ARM's customer should have the right to verify , at the supplier premises that the product and subcontracted products are conform to specified requirements	If instances require, Webasto audits the supplier's processes. Typical reasons may be launches of new products, engineering changes, or insufficient performance of the supplier. Also it is usual to repeat the evaluation of the production processes on a regular basis.	JD will perform a Supplier Quality System Audit as part of the supplier assessment

	BROSE	**ARVIN MERITOR**	**WEBASTO**	**JOHN DEERE**
Supplier qualification	Brose will perform technology audits at each new supplier or suppliers facility	10 criteria mentioned as a basis requirements for supplier e.g. system to deliver defect free products evidence to follow AIAG APQP and PPAP utilize appropriate statistical techniques for SPC develop and implement a documented quality system….	evaluation by Webasto purchasing and Webcast supplier audit has to be passed successfully-> Approved supplier list	This Red Flags Survey is designed for a first time visit to a potential direct or indirect material supplier to evaluate their in-house quality system and decide if they are advanced enough to be considered as a potential supplier for John Deere.
Supplier evaluation	The supplier performance is evaluated on quality, project management, logistics and by Brose purchasing. Below A grading supplier must create and implement an action plan	Key supplier score card on continuous improvement , total cost management, operational excellence, globalization and technology	Rating is done on quality performance, rating of the efficiency of problem solving methods, logistic performance and escalation.	John Deere " Achieving Excellence Process"
sub suppliers	Supplier must develop the QM system of his advance suppliers to meet TS 16949 requirements	Each AEM supplier is responsible for the control and continuous improvement of its supplier.	The supplier has to assure the effectiveness of sub-contractors quality management system in accordance with the principles and rule of ISO/TS 16949:2009; the supplier is further required to regularly conduct product, process and system audits with the subcontractor.	John Deere expects our suppliers to obtain appropriate data and apply statistical and problem solving techniques to solve specific problems and to drive continuous improvement activities. The supplier shall analyze the following: • Achieving Excellence results • Internal and external product failures (including warranty) • Process or product quality trends • Supply chain (including sub tier supply chain) quality performance

	BROSE	ARVIN MERITOR	WEBASTO	JOHN DEERE
Product or process changes	supplier has to inform Brose about any product or process change in time to allow Brose all necessary actions (validation and long term test, approval by OEMs)	notification prior to any change by ARM form, authorization from ARM required	Changes on approved parts and processes require a customer notification according to procedure used for submitting samples. These changes shall not be implemented prior to their official approval from Webasto.	A supplier shall request approval from John Deere before making changes to a specification or process for supplied products or services for any change that may impact safety, fit, form, function, performance, durability, or appearance per the following requirements listed in Table T.7.2.3.#1.
Problem solving requirements	Supplier shall respond immediately to complaints made by Brose. 8D repot with immediate action within 24 hours. Cause of problem and corrective measure within 5 calendar days	supplier must have a defined and structured process like 8D, Six Sigma, verification of root cause and validation of corrective action effectiveness	delivery of defect free parts to webcast production line has highest priority, 8 D process is in place , point 1-3 should be delivered within 24 hours	Suppliers shall investigate resolution to nonconformities using eight Corrective Action steps or Resolution Phases. (8D)
Requalification	Requalification has to be performed according the requirements of ISO7Ts 16949 and QS 9000	supplier shall inspect and test annually a sample of each active product supplied to assure conformance to all ARM specified requirements. These requirements have to be specified in the production control plan	supplier shall verify on an annual basis that the products fulfills all Webasto's requirements by testing an agreed on quantity of random samples from series production. Test results must be documented and made available to Webasto in due time. This testing must be described in the control plan	no specific requirement

Appendix 5, Mapping of quality requirement specification